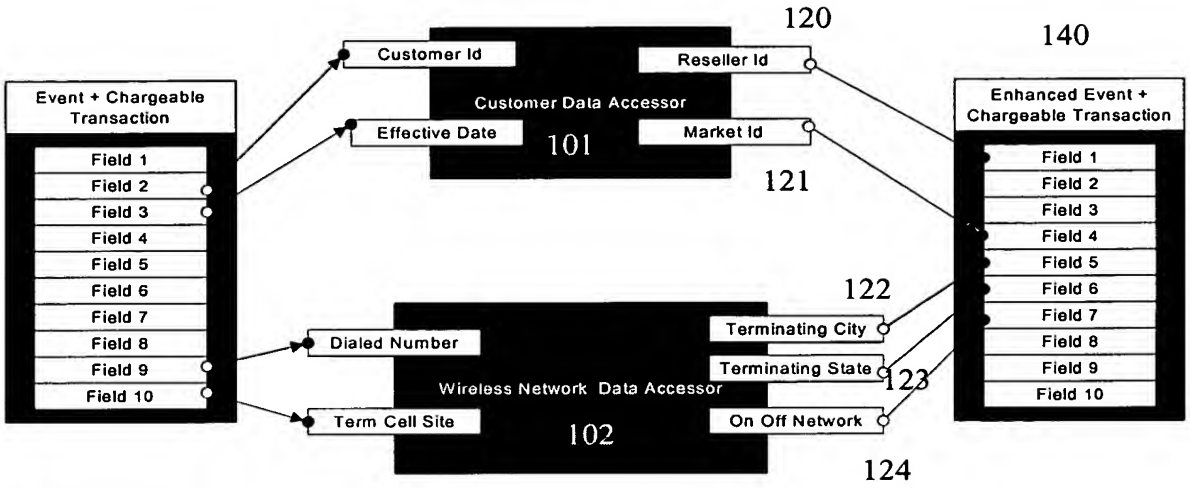
120
140
Customer Id
Reseller Id
Customer Data Accessor
Event + Chargeable Transaction
Effective Date
101
Market Id
Enhanced Event + Chargeable Transaction
Field 1
Field 2
Field 3
Field 4
Field 5
Field 6
Field 7
Field 8
Field 9
Field 10
121
122
Terminating City
Dialed Number
Terminating State
123
Wireless Network Data Accessor
Term Cell Site
102
On Off Network
124

Figure 1

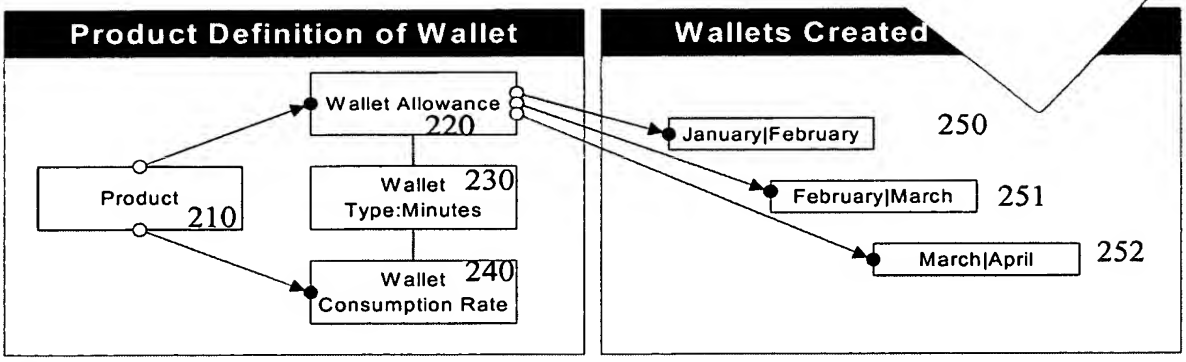
Product Definition of Wallet
Wallet Allowance
220
Product
210
Wallet
Type:Minutes
230
Wallet
Consumption Rate
240
Wallets Created
January|February
250
February|March
251
March|April
252

Figure 2

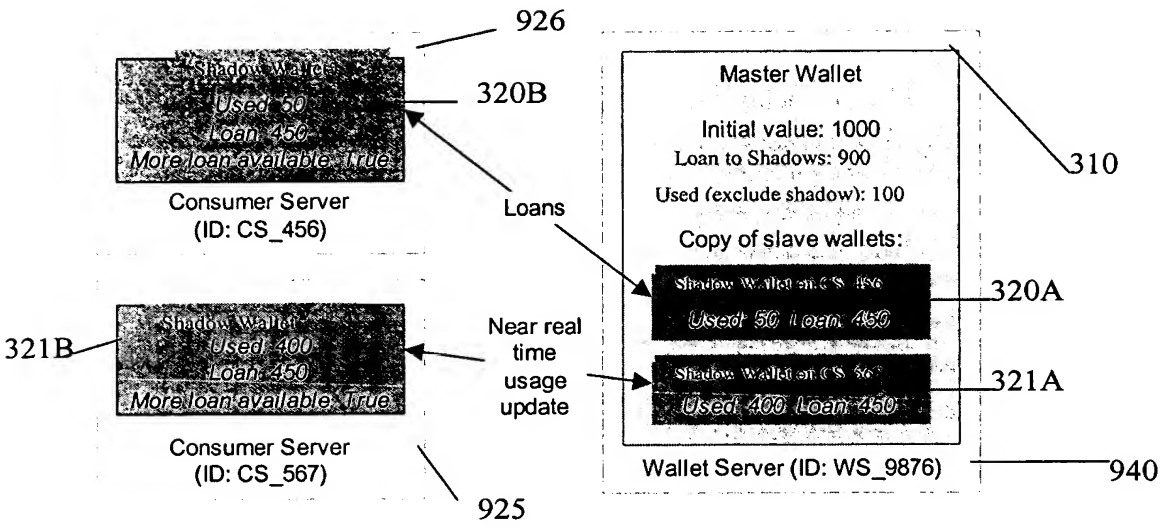
926
Shadow Wallet
Used: 50
Loan: 450
More loan available: True
320B
Consumer Server
(ID: CS_456)
Loans
Master Wallet
Initial value: 1000
Loan to Shadows: 900
Used (exclude shadow): 100
Copy of slave wallets:
310
320A
Used: 50 Loan: 450
321B
Shadow Wallet
Used: 400
Loan: 450
More loan available: True
Near real
time
usage
update
321A
Used: 400 Loan: 450
Consumer Server
(ID: CS_567)
925
Wallet Server (ID: WS_9876)
940

Figure 3

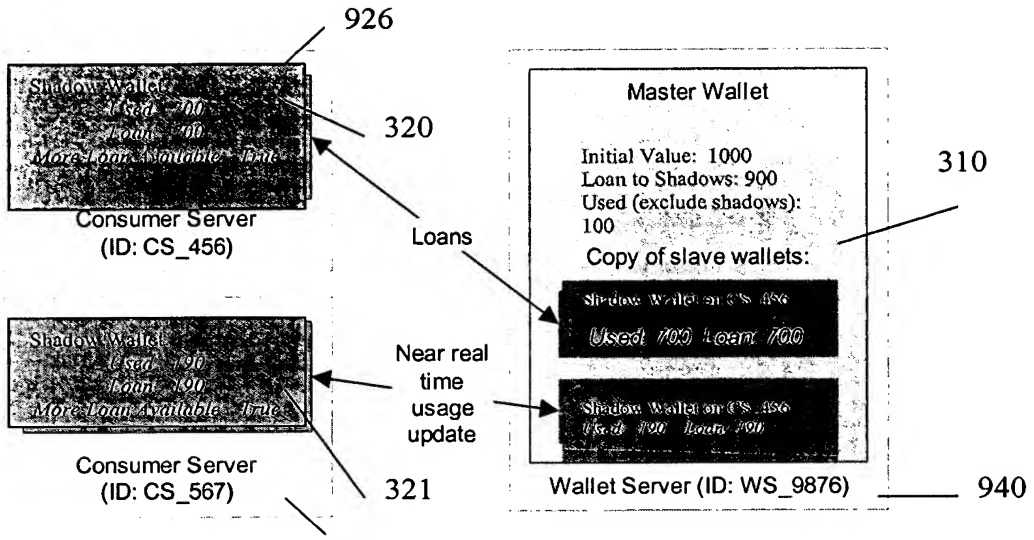
926
Shadow Wallet:
Used: 700
Loan: 700
More Loan Available: true
320
Consumer Server
(ID: CS_456)
Loans
Master Wallet
Initial Value: 1000
Loan to Shadows: 900
Used (exclude shadows):
100
310
Copy of slave wallets:
Shadow Wallet on CS_456
Used: 700 Loan: 700
Near real
time
usage
update
Shadow Wallet:
Used: 90
Loan: 190
More Loan Available: true
Shadow Wallet on CS_456
Used: 700 Loan: 700
Consumer Server
(ID: CS_567)
321
Wallet Server (ID: WS_9876)
940
925

Figure 4

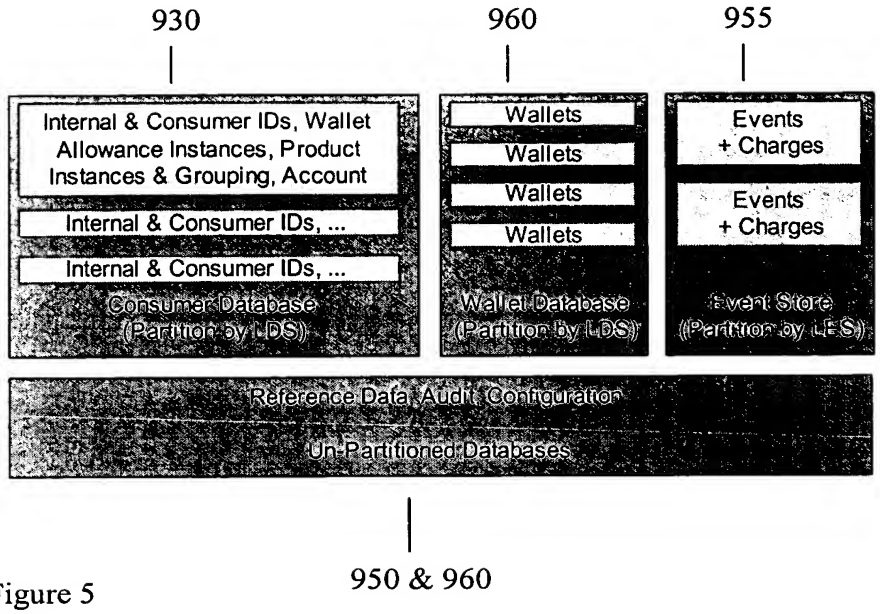
930
960
955
Internal & Consumer IDs, Wallet Allowance Instances, Product Instances & Grouping, Account
Internal & Consumer IDs, ...
Internal & Consumer IDs, ...
Consumer Database (Partition by LDS)
Wallets
Wallets
Wallets
Wallets
Wallet Database (Partition by LDS)
Events + Charges
Events + Charges
Event Store (Partition by LES)
Reference Data, Audit, Configuration
Un-Partitioned Databases
950 & 960

Figure 5

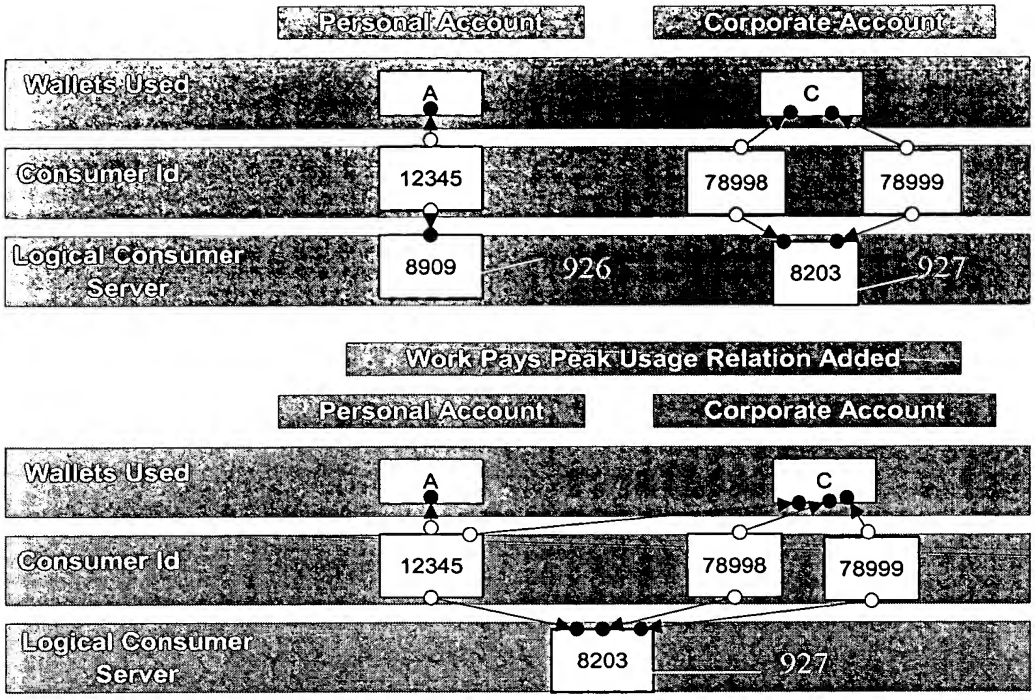
Personal Account
Corporate Account
Wallets Used
A
C
Consumer Id
12345
78998
78999
Logical Consumer Server
8909
926
8203
927
Work Pays Peak Usage Relation Added
Personal Account
Corporate Account
Wallets Used
A
C
Consumer Id
12345
78998
78999
Logical Consumer Server
8203
927

Figure 6

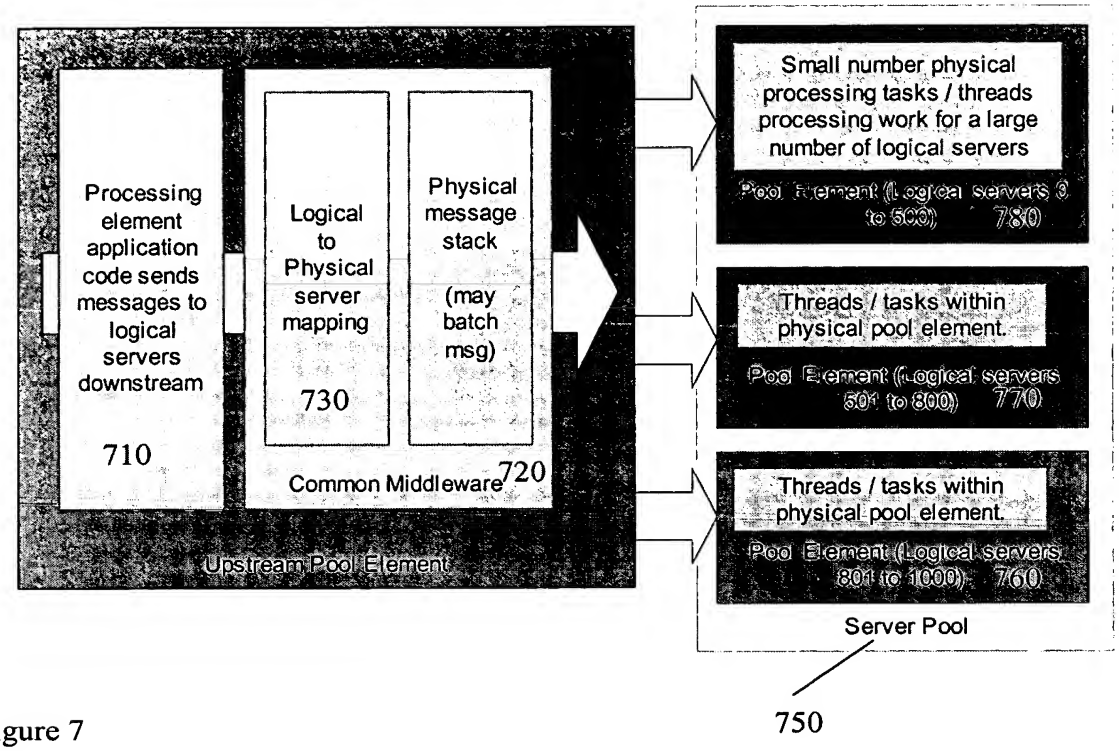
Processing element application code sends messages to logical servers downstream
710
Logical to Physical server mapping
730
Physical message stack
(may batch msg)
Common Middleware
720
Upstream Pool Element
Small number physical processing tasks / threads processing work for a large number of logical servers
Pool Element (Logical servers 0 to 500)
780
Threads / tasks within physical pool element.
Pool Element (Logical servers 501 to 800)
770
Threads / tasks within physical pool element.
Pool Element (Logical servers 801 to 1000)
760
Server Pool
750

Figure 7

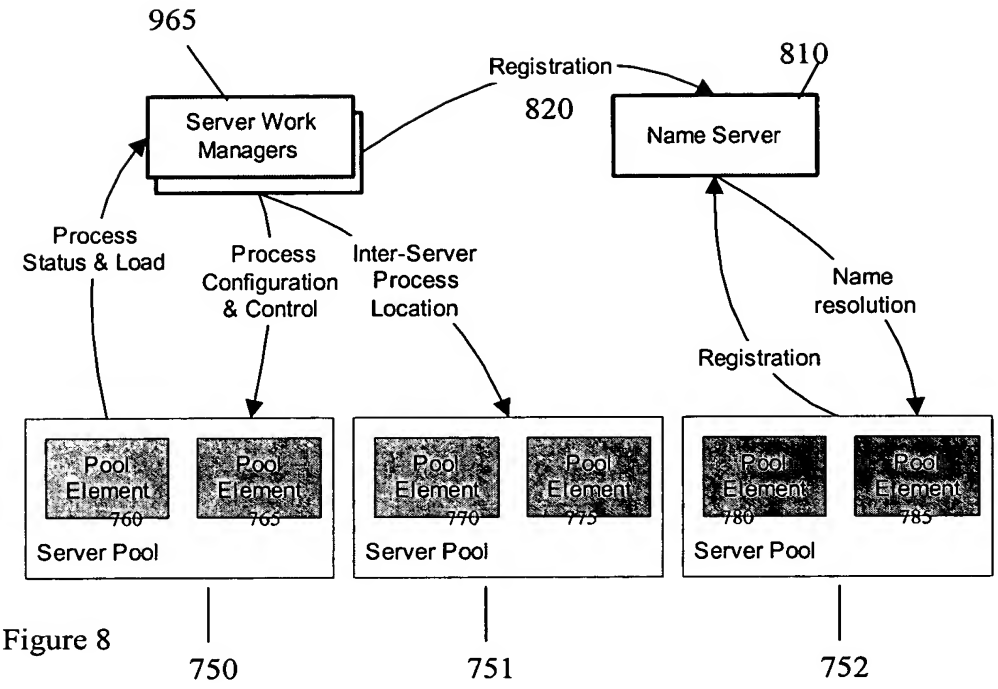
965
Server Work Managers
Registration
820
810
Name Server
Process Status & Load
Process Configuration & Control
Inter-Server Process Location
Registration
Name resolution
Pool Element
760
Pool Element
765
Server Pool
Pool Element
770
Pool Element
775
Server Pool
Pool Element
780
Pool Element
785
Server Pool
750
751
752

Figure 8

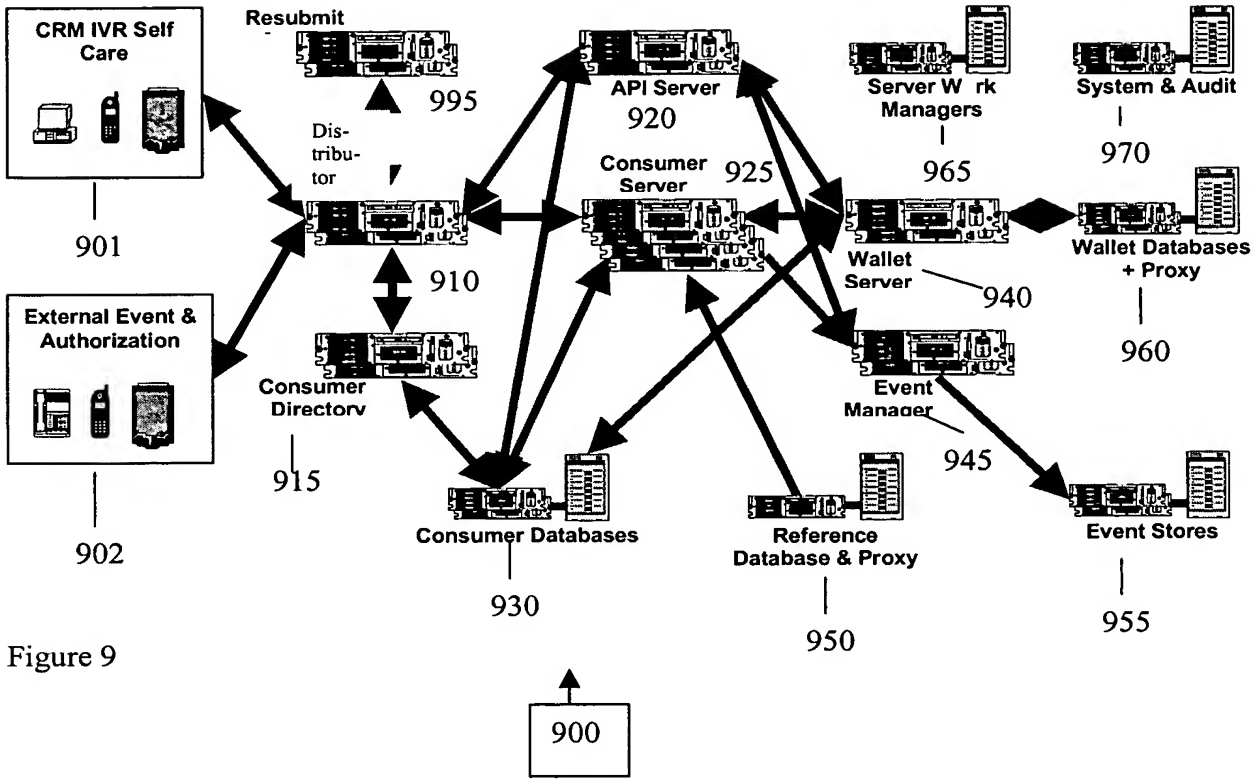
CRM IVR Self Care
901
External Event & Authorization
902
Resubmit
995
Dis-tribu-tor
910
Consumer Directory
915
API Server
920
Consumer Server
925
Consumer Databases
930
Server W rk Managers
965
Wallet Server
940
Event Manager
945
Reference Database & Proxy
950
System & Audit
970
Wallet Databases + Proxy
960
Event Stores
955
900

Figure 9

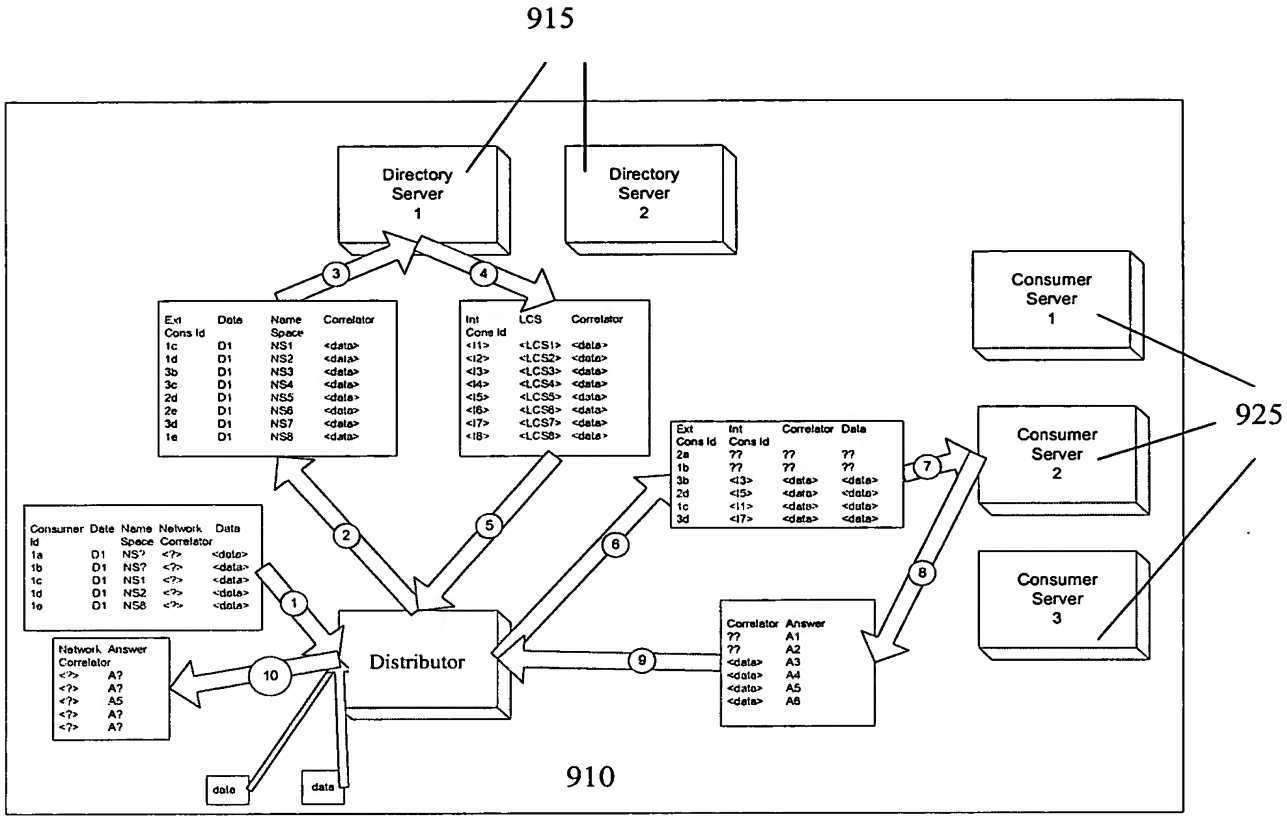
915
Directory Server 1
Directory Server 2
Consumer Server 1
Consumer Server 2
Consumer Server 3
925
910
Distributor
Ext Cons Id | Date | Name Space | Correlator
1c D1 NS1 <data>
1d D1 NS2 <data>
3b D1 NS3 <data>
3c D1 NS4 <data>
2d D1 NS5 <data>
2e D1 NS6 <data>
3d D1 NS7 <data>
1e D1 NS8 <data>
Int Cons Id | LCS | Correlator
<I1> <LCS1> <data>
<I2> <LCS2> <data>
<I3> <LCS3> <data>
<I4> <LCS4> <data>
<I5> <LCS5> <data>
<I6> <LCS6> <data>
<I7> <LCS7> <data>
<I8> <LCS8> <data>
Ext Cons Id | Int Cons Id | Correlator | Data
2a ?? ?? ??
1b ?? ?? ??
3b <I3> <data> <data>
2d <I5> <data> <data>
1c <I1> <data> <data>
3d <I7> <data> <data>
Consumer Id | Date | Name Space | Network Correlator | Data
1a D1 NS? <?> <data>
1b D1 NS? <?> <data>
1c D1 NS1 <?> <data>
1d D1 NS2 <?> <data>
1e D1 NS8 <?> <data>
Network Correlator | Answer
<?> A?
<?> A?
<?> A5
<?> A?
<?> A?
Correlator | Answer
?? A1
?? A2
<data> A3
<data> A4
<data> A5
<data> A6
data
data
1
2
3
4
5
6
7
8
9
10

Figure 10

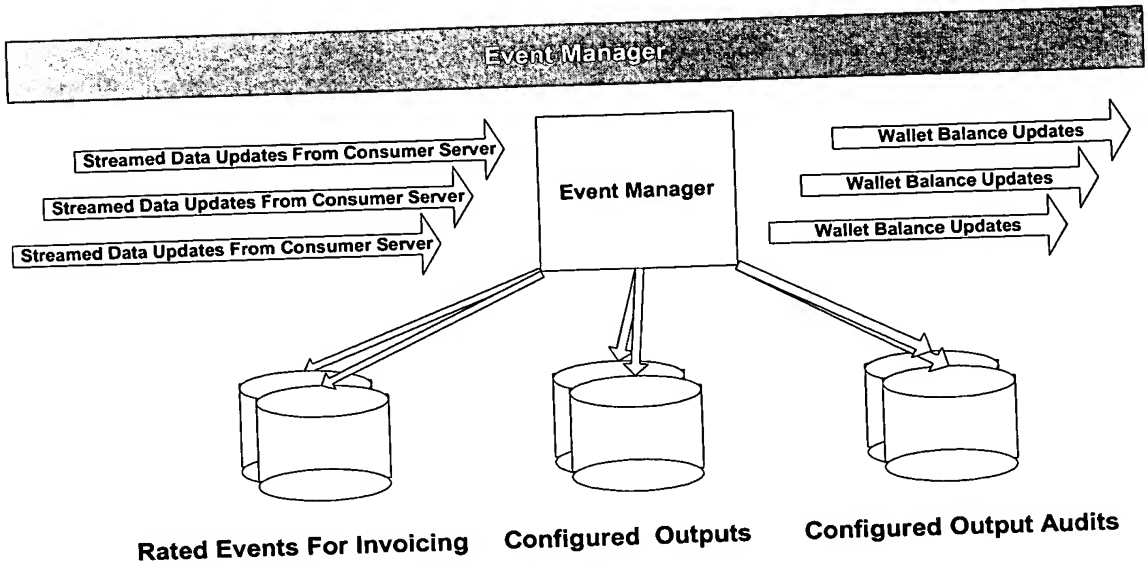
Event Manager
Streamed Data Updates From Consumer Server
Streamed Data Updates From Consumer Server
Streamed Data Updates From Consumer Server
Event Manager
Wallet Balance Updates
Wallet Balance Updates
Wallet Balance Updates
Rated Events For Invoicing
Configured Outputs
Configured Output Audits

Figure 11

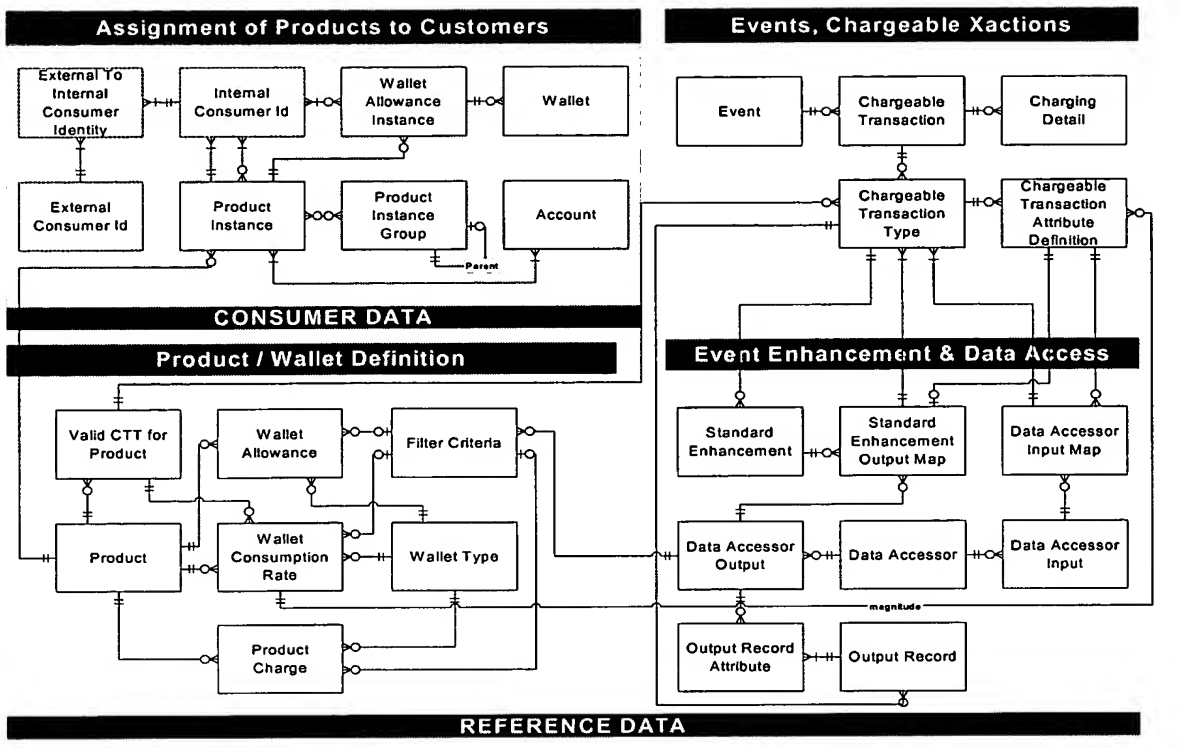
Assignment of Products to Customers
Events, Chargeable Xactions
External To Internal Consumer Identity
Internal Consumer Id
Wallet Allowance Instance
Wallet
External Consumer Id
Product Instance
Product Instance Group
Account
Parent
Event
Chargeable Transaction
Charging Detail
Chargeable Transaction Type
Chargeable Transaction Attribute Definition
CONSUMER DATA
Product / Wallet Definition
Event Enhancement & Data Access
Valid CTT for Product
Wallet Allowance
Filter Criteria
Standard Enhancement
Standard Enhancement Output Map
Data Accessor Input Map
Product
Wallet Consumption Rate
Wallet Type
Data Accessor Output
Data Accessor
Data Accessor Input
magnitude
Product Charge
Output Record Attribute
Output Record
REFERENCE DATA

Figure 12

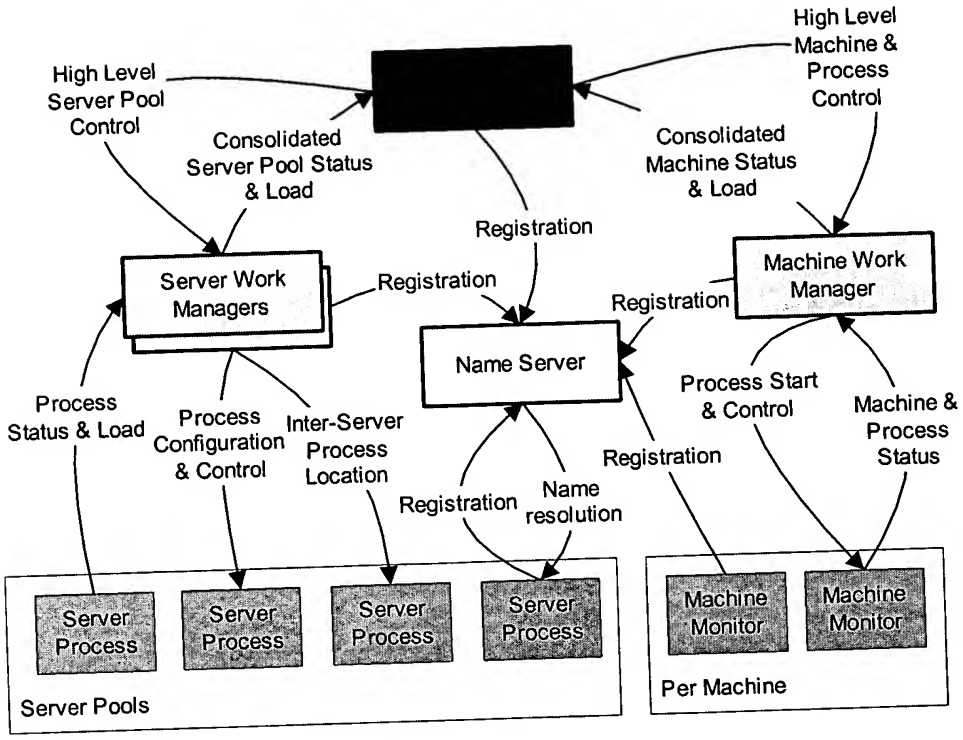
High Level
Server Pool
Control
Consolidated
Server Pool Status
& Load
High Level
Machine &
Process
Control
Consolidated
Machine Status
& Load
Registration
Server Work
Managers
Registration
Machine Work
Manager
Registration
Name Server
Process
Status & Load
Process
Configuration
& Control
Inter-Server
Process
Location
Registration
Name
resolution
Registration
Process Start
& Control
Machine &
Process
Status
Server
Process
Server
Process
Server
Process
Server
Process
Machine
Monitor
Machine
Monitor
Server Pools
Per Machine

Figure 13

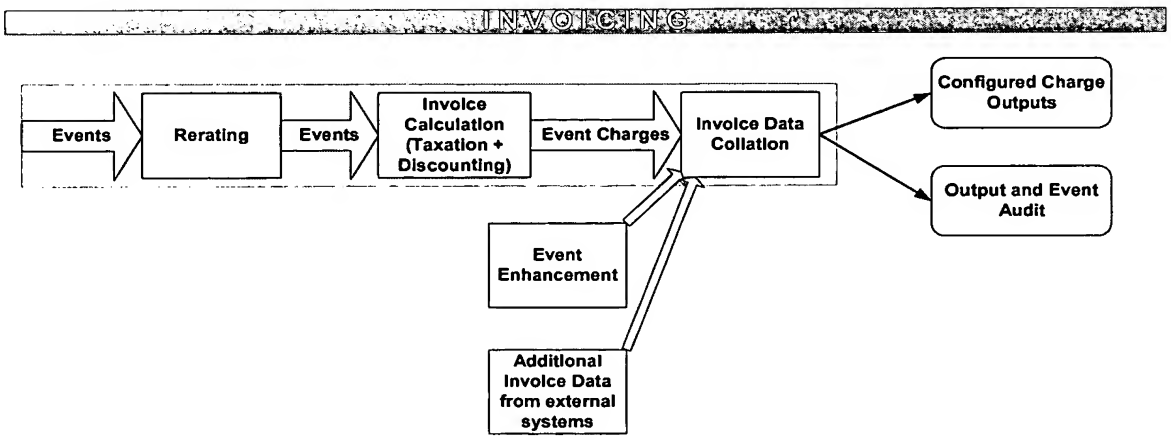
INVOICING
Events
Rerating
Events
Invoice Calculation (Taxation + Discounting)
Event Charges
Invoice Data Collation
Configured Charge Outputs
Output and Event Audit
Event Enhancement
Additional Invoice Data from external systems

Figure 14

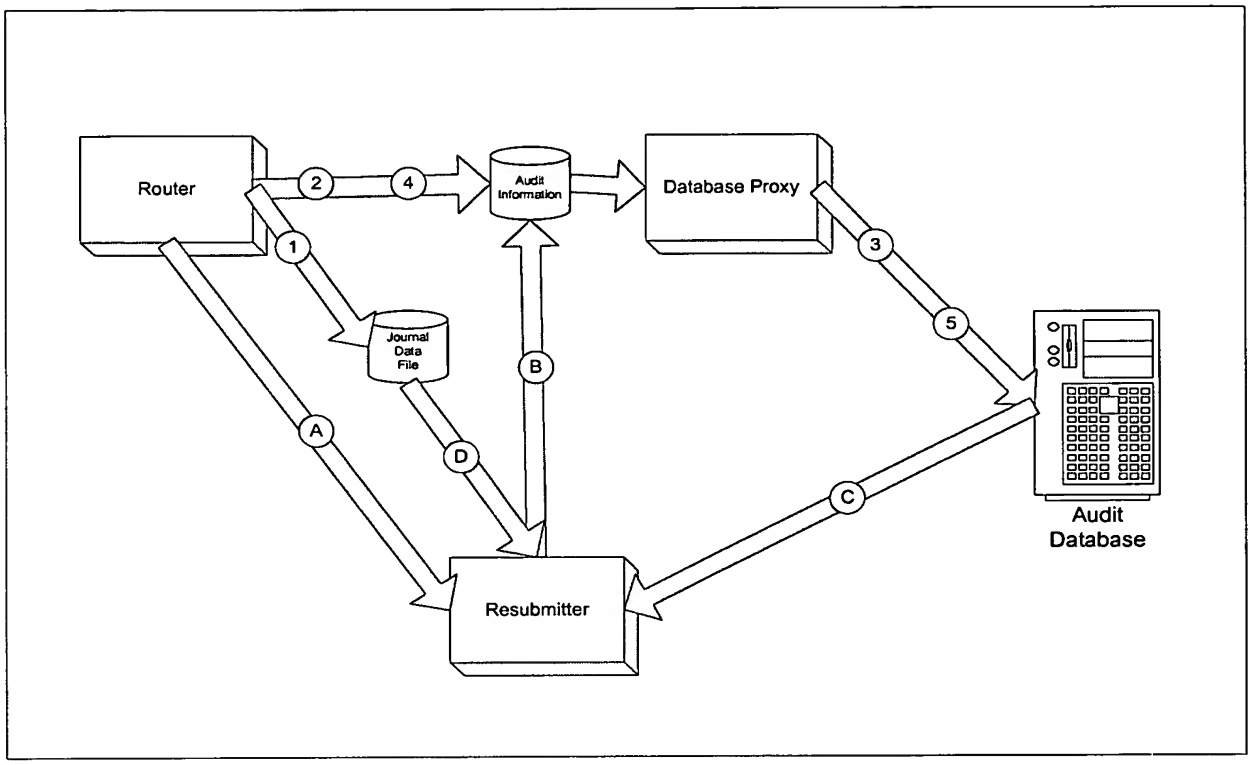
Router
2
4
Audit Information
Database Proxy
1
3
Journal Data File
5
B
A
D
C
Audit Database
Resubmitter

Figure 15

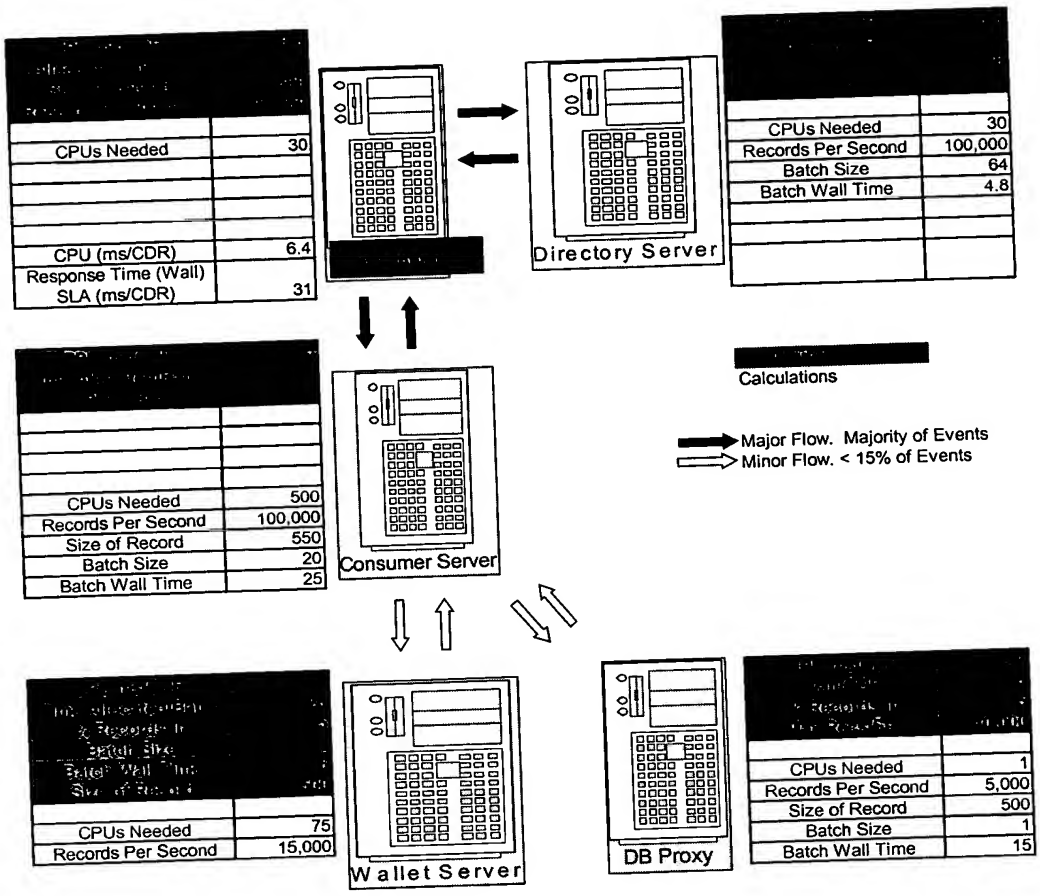
CPUs Needed 30
CPU (ms/CDR) 6.4
Response Time (Wall) SLA (ms/CDR) 31
Directory Server
CPUs Needed 30
Records Per Second 100,000
Batch Size 64
Batch Wall Time 4.8
Calculations
Major Flow. Majority of Events
Minor Flow. < 15% of Events
CPUs Needed 500
Records Per Second 100,000
Size of Record 550
Batch Size 20
Batch Wall Time 25
Consumer Server
CPUs Needed 75
Records Per Second 15,000
Wallet Server
DB Proxy
CPUs Needed 1
Records Per Second 5,000
Size of Record 500
Batch Size 1
Batch Wall Time 15

Figure 16

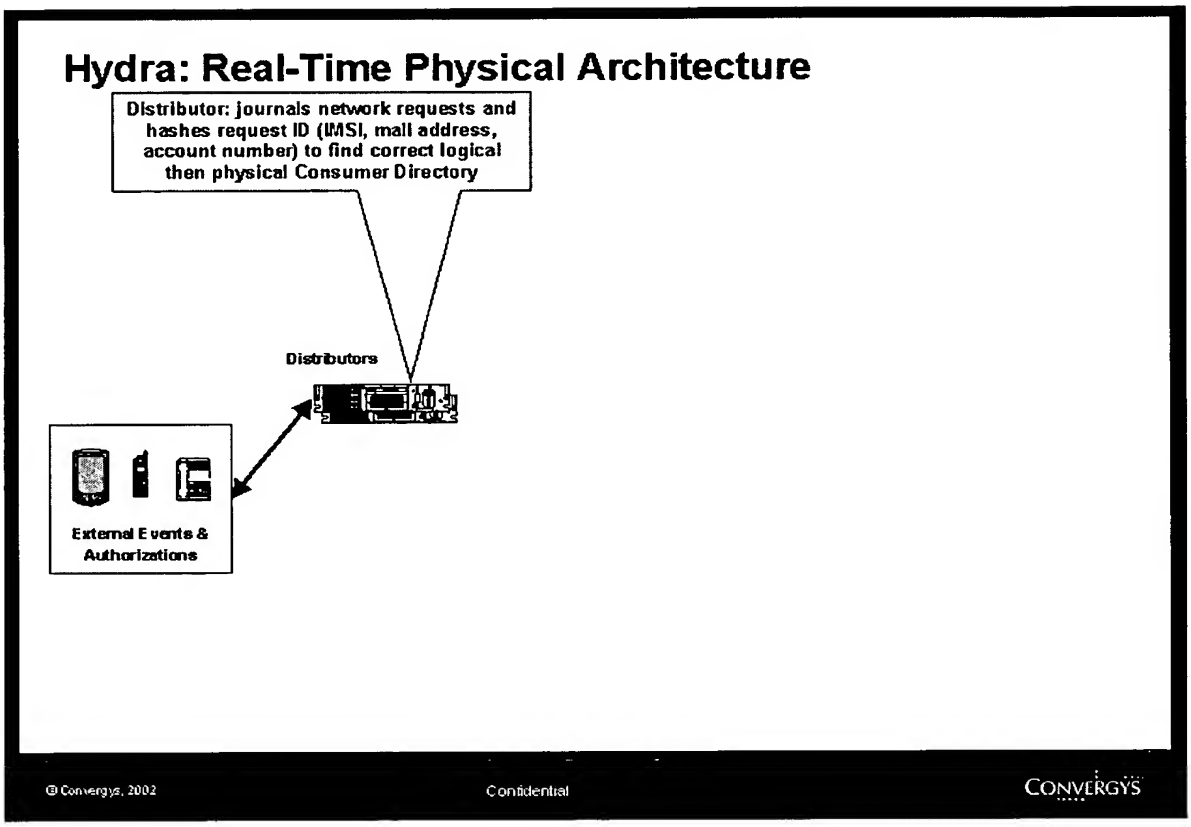
Hydra: Real-Time Physical Architecture
Distributor: journals network requests and hashes request ID (IMSI, mail address, account number) to find correct logical then physical Consumer Directory
Distributors
External Events & Authorizations
© Convergys, 2002
Confidential
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Figure 17

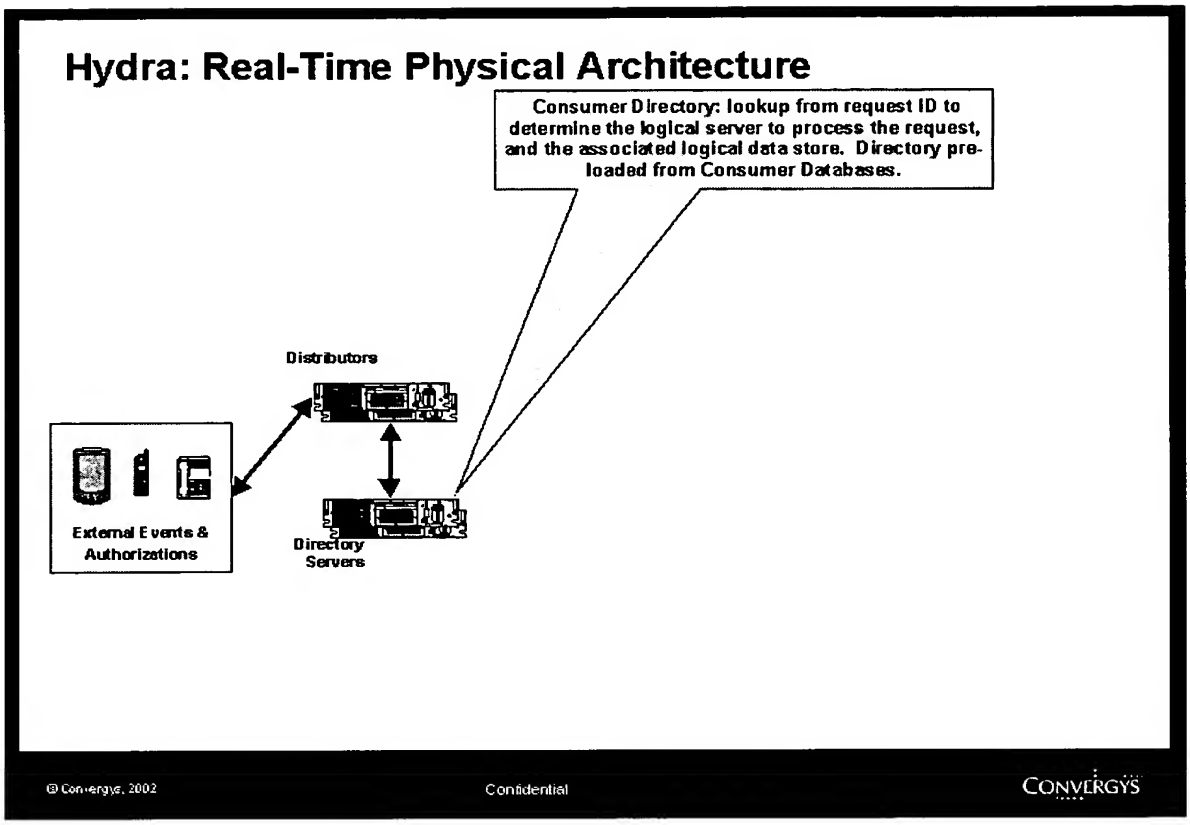
Hydra: Real-Time Physical Architecture
Consumer Directory: lookup from request ID to determine the logical server to process the request, and the associated logical data store. Directory pre-loaded from Consumer Databases.
Distributors
External Events & Authorizations
Directory Servers
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Figure 18

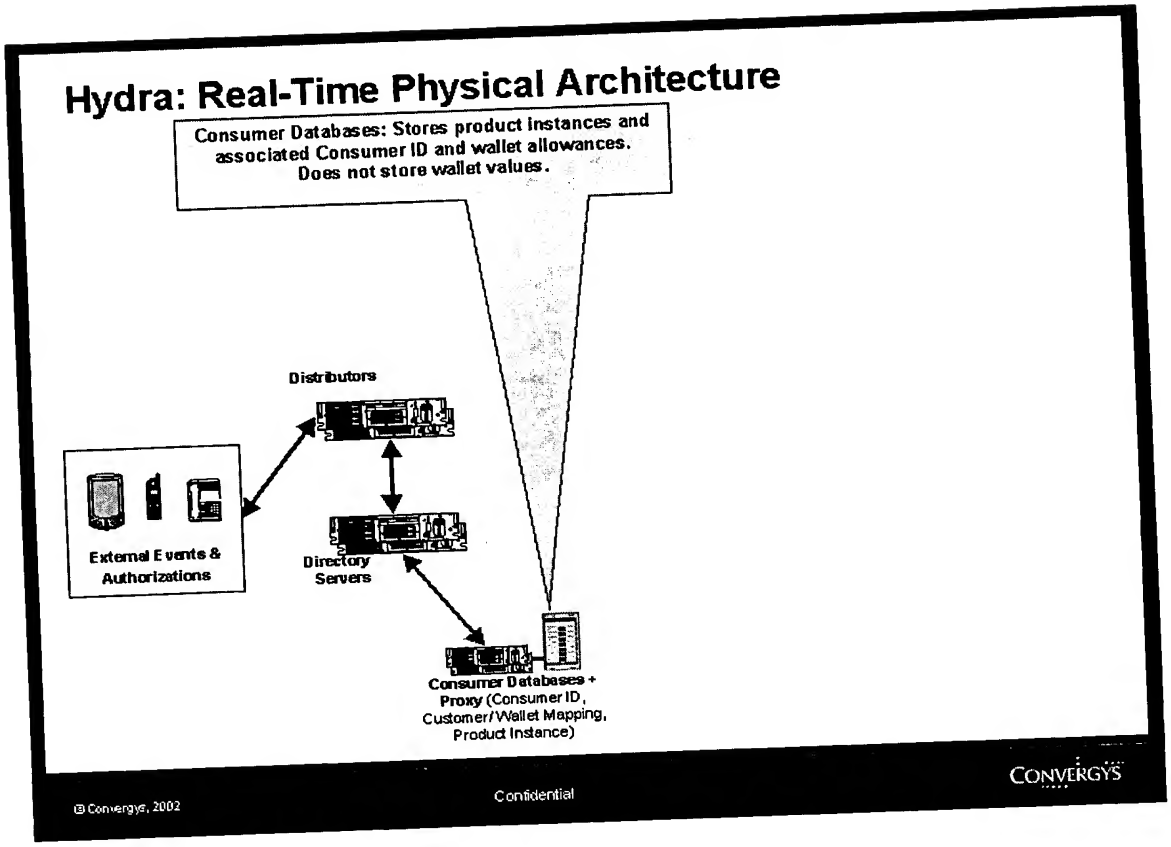
Hydra: Real-Time Physical Architecture
Consumer Databases: Stores product instances and associated Consumer ID and wallet allowances. Does not store wallet values.
Distributors
External Events & Authorizations
Directory Servers
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
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Figure 19

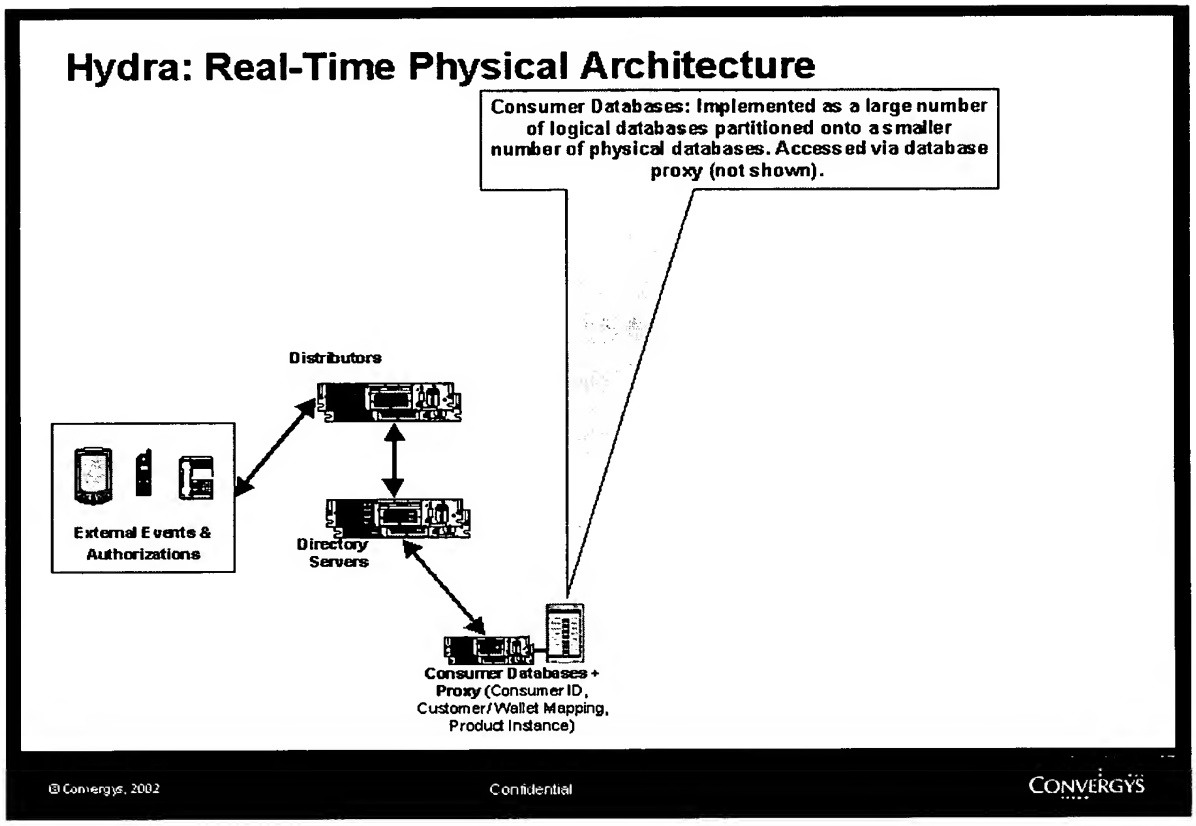
Hydra: Real-Time Physical Architecture
Consumer Databases: Implemented as a large number of logical databases partitioned onto a smaller number of physical databases. Accessed via database proxy (not shown).
Distributors
External Events & Authorizations
Directory Servers
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
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Figure 20

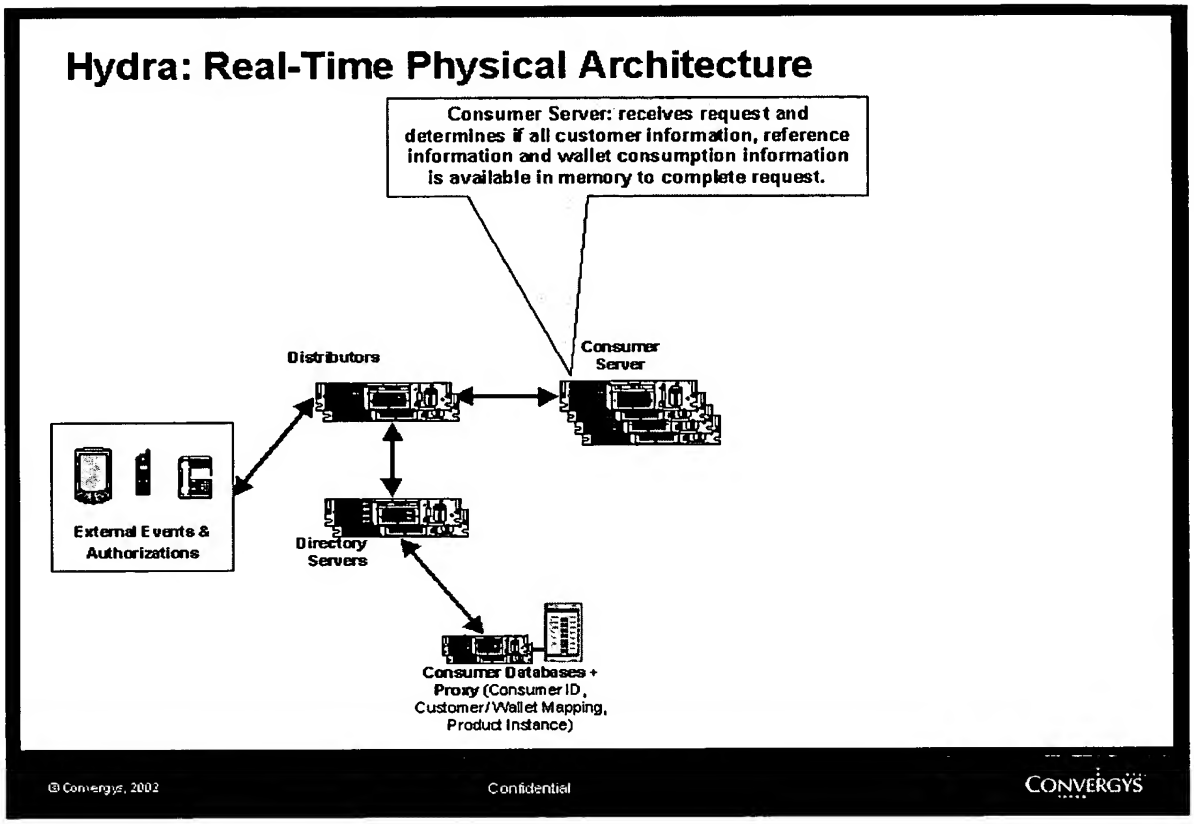
Hydra: Real-Time Physical Architecture
Consumer Server: receives request and determines if all customer information, reference information and wallet consumption information is available in memory to complete request.
Distributors
Consumer Server
External Events & Authorizations
Directory Servers
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
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Figure 21

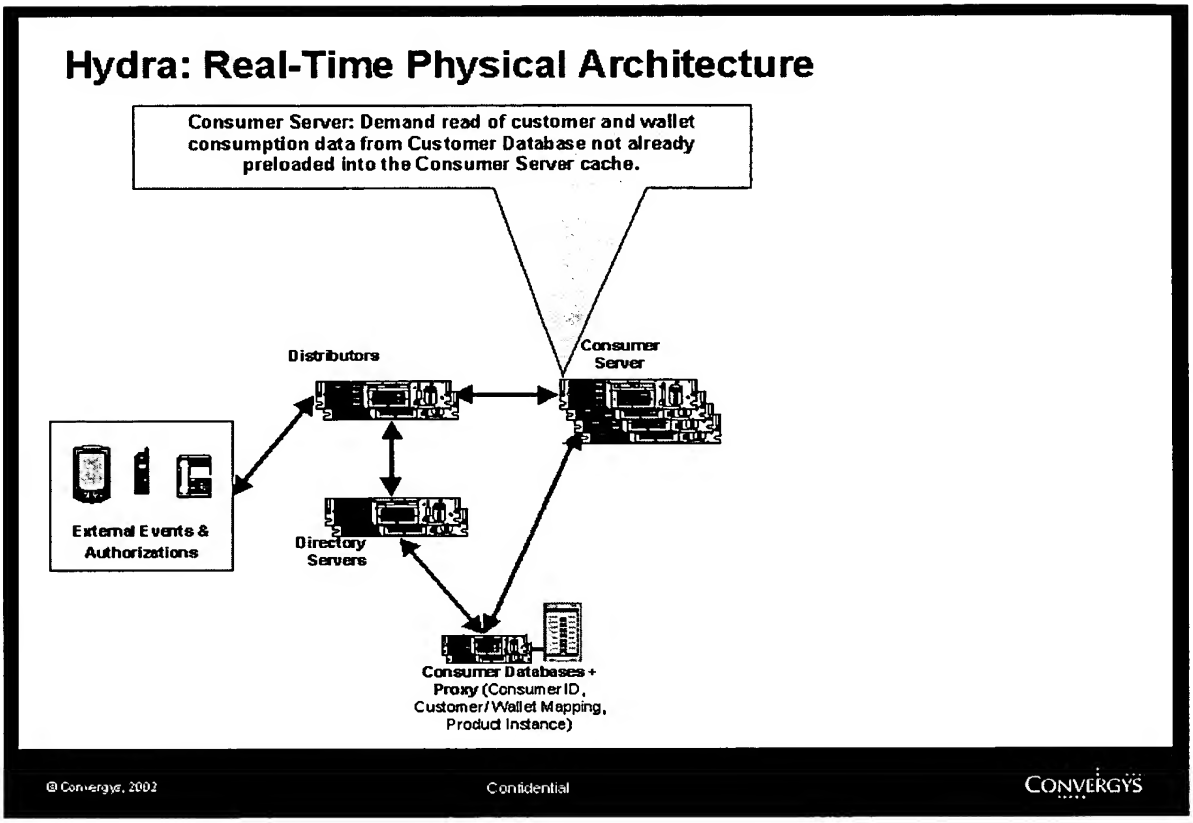
Hydra: Real-Time Physical Architecture
Consumer Server: Demand read of customer and wallet consumption data from Customer Database not already preloaded into the Consumer Server cache.
Distributors
Consumer Server
External Events & Authorizations
Directory Servers
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
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Figure 22

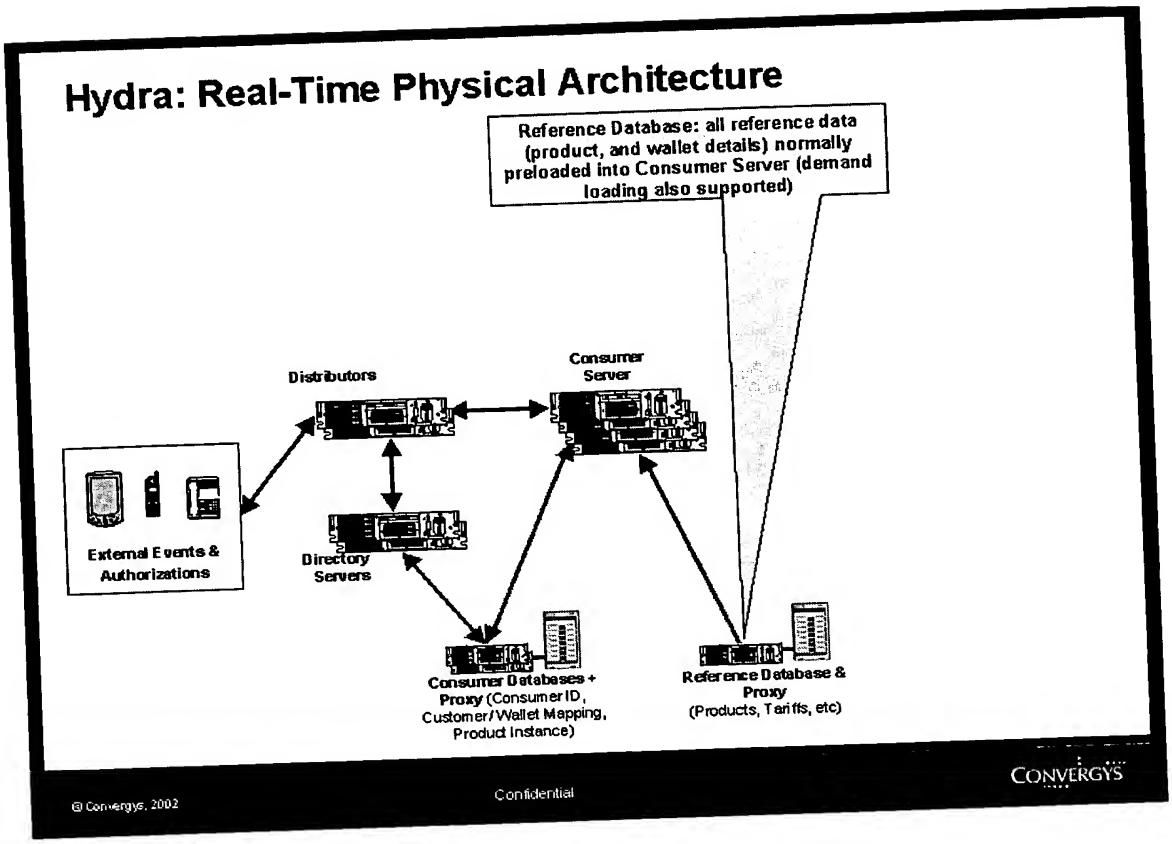
Hydra: Real-Time Physical Architecture
Reference Database: all reference data (product, and wallet details) normally preloaded into Consumer Server (demand loading also supported)
Distributors
Consumer Server
External Events & Authorizations
Directory Servers
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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Figure 23

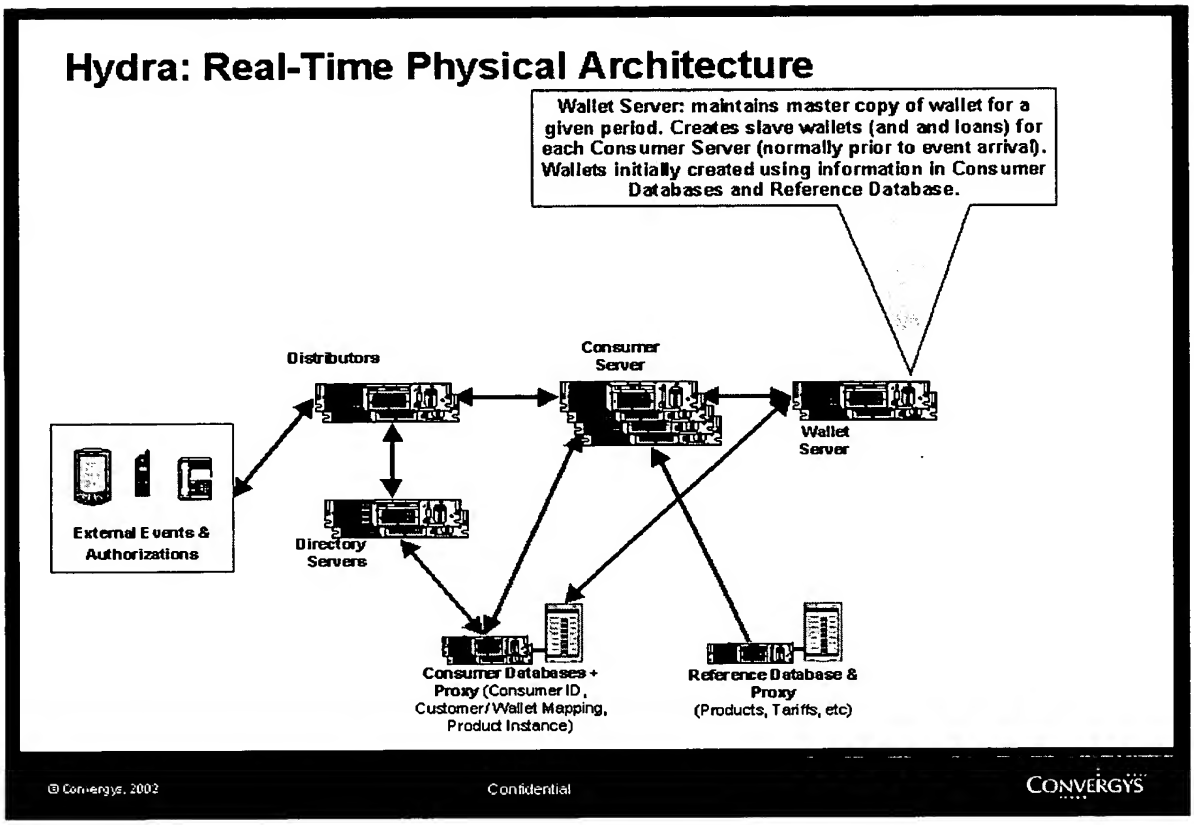
Hydra: Real-Time Physical Architecture
Wallet Server: maintains master copy of wallet for a given period. Creates slave wallets (and and loans) for each Consumer Server (normally prior to event arrival). Wallets initially created using information in Consumer Databases and Reference Database.
Distributors
Consumer Server
Wallet Server
External Events & Authorizations
Directory Servers
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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Figure 24

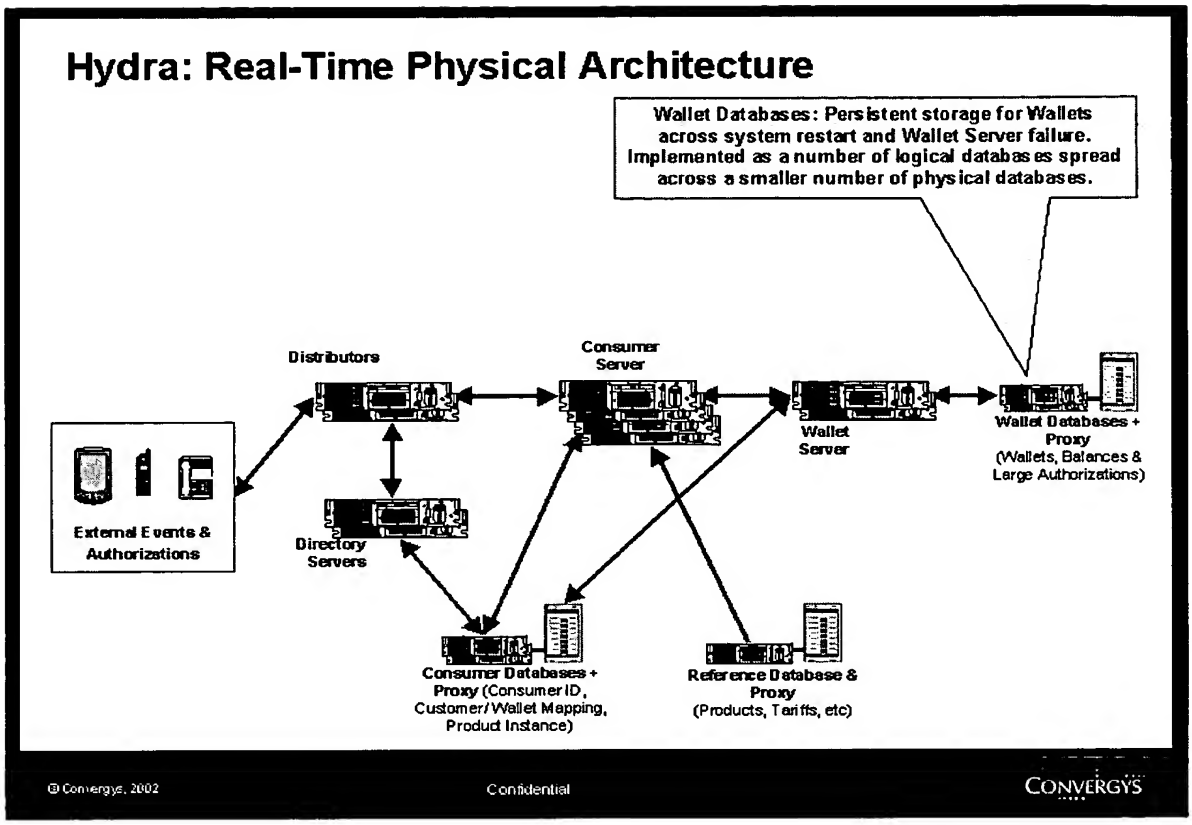
Hydra: Real-Time Physical Architecture
Wallet Databases: Persistent storage for Wallets across system restart and Wallet Server failure. Implemented as a number of logical databases spread across a smaller number of physical databases.
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
External Events & Authorizations
Directory Servers
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Produd Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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Figure 25

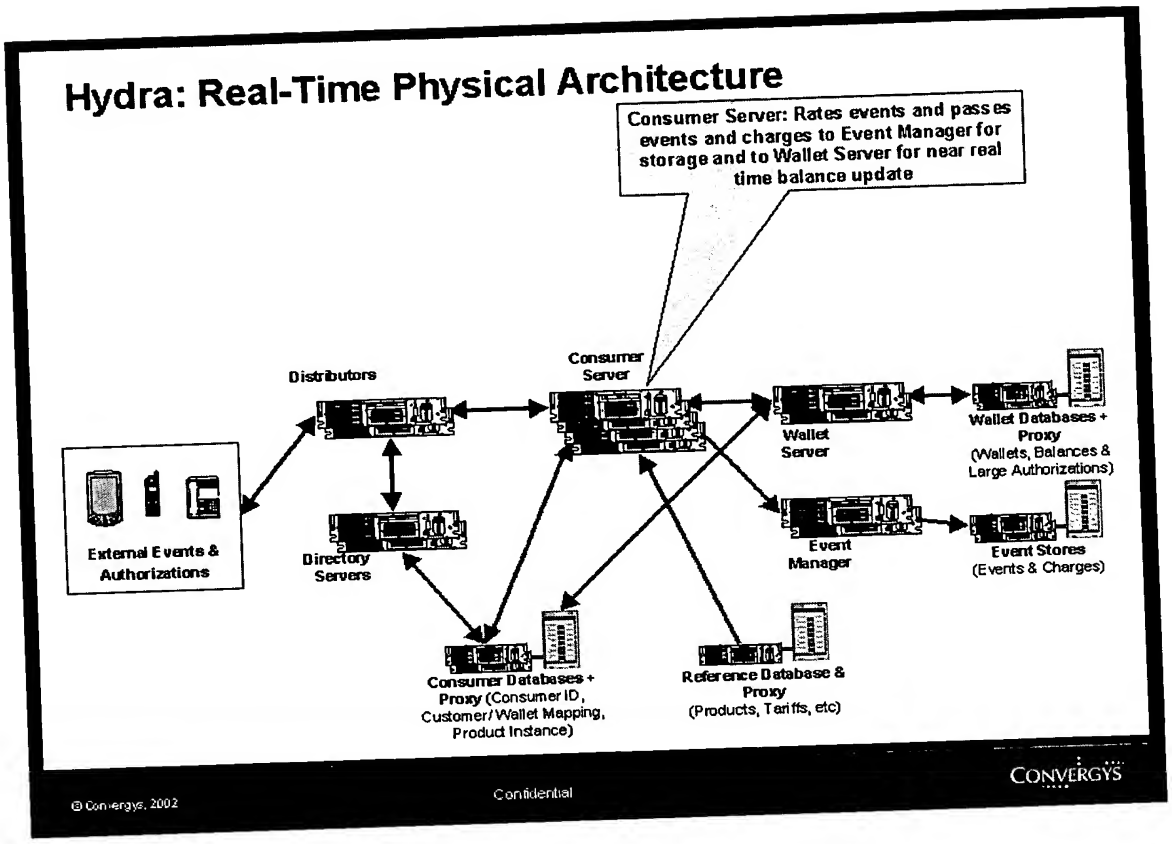
Hydra: Real-Time Physical Architecture
Consumer Server: Rates events and passes events and charges to Event Manager for storage and to Wallet Server for near real time balance update
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
External Events & Authorizations
Directory Servers
Event Manager
Event Stores (Events & Charges)
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
© Convergys, 2002
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Figure 26

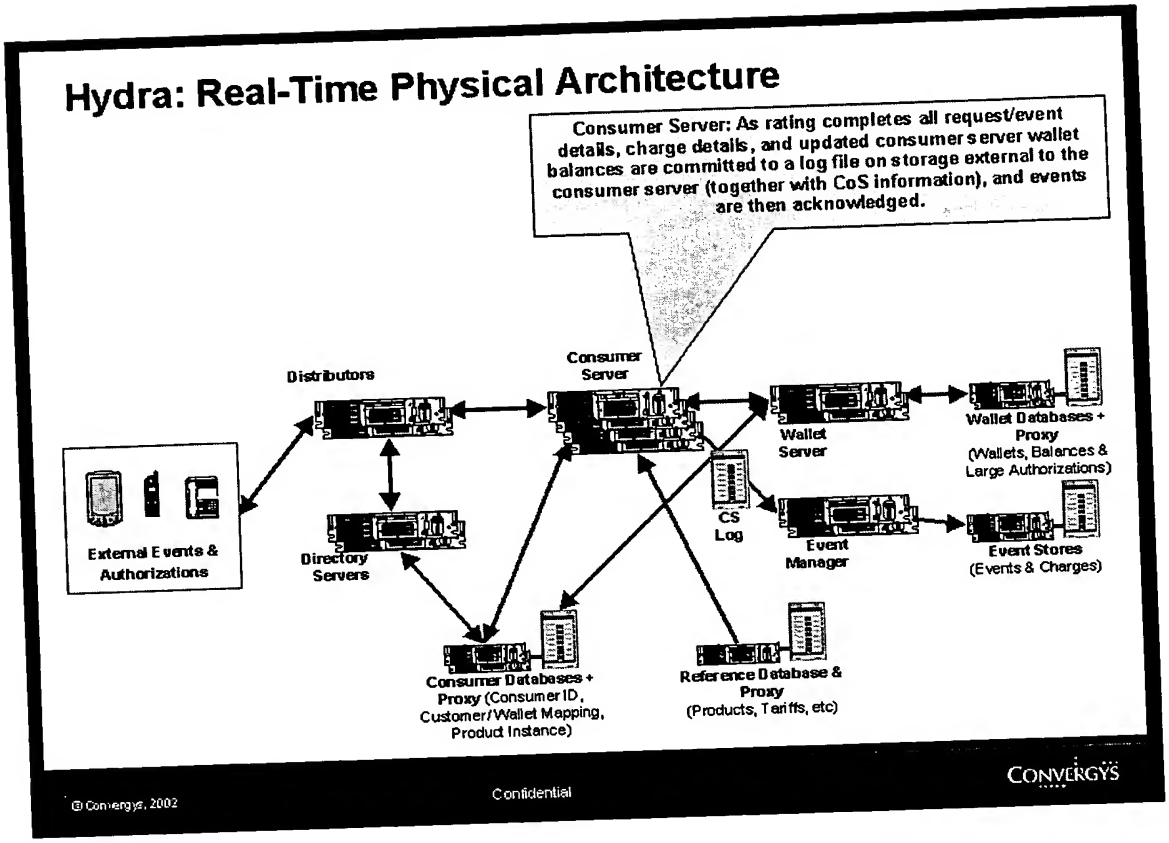
Hydra: Real-Time Physical Architecture
Consumer Server: As rating completes all request/event details, charge details, and updated consumer server wallet balances are committed to a log file on storage external to the consumer server (together with CoS information), and events are then acknowledged.
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
External Events & Authorizations
Directory Servers
CS Log
Event Manager
Event Stores (Events & Charges)
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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Figure 27

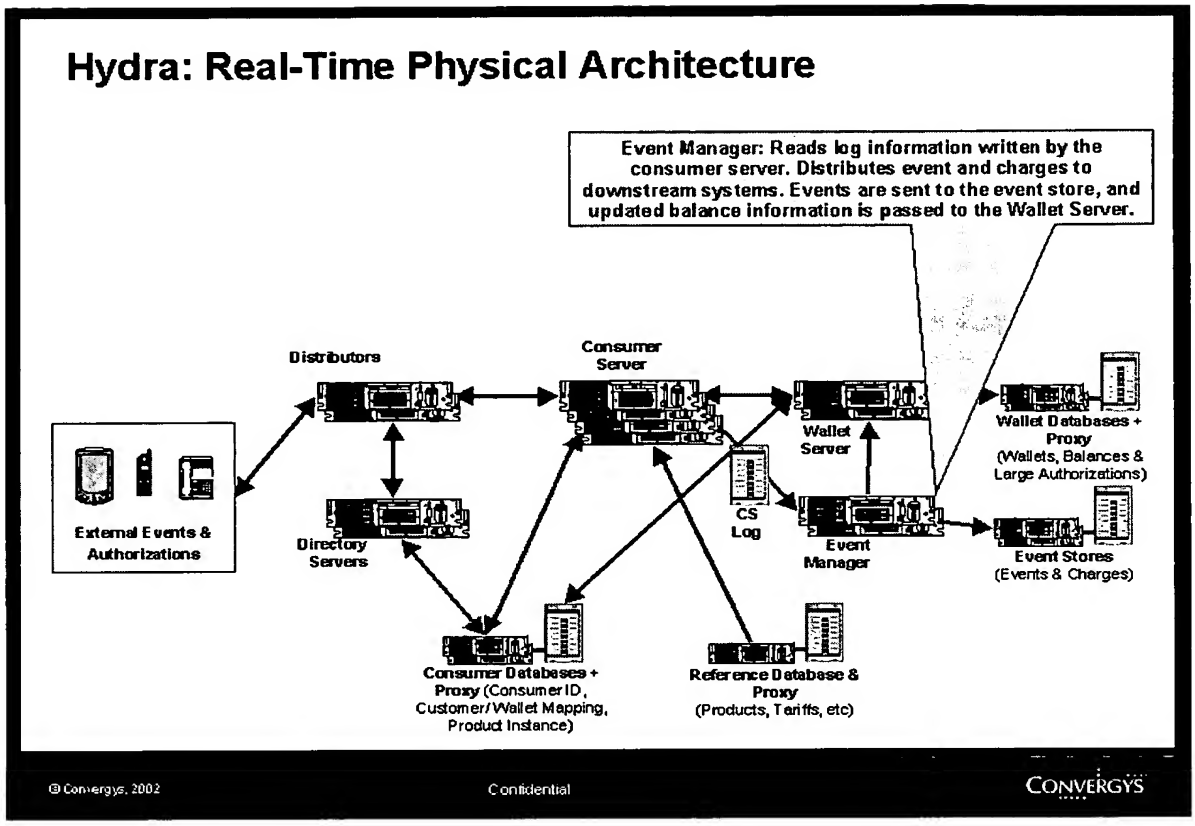
Hydra: Real-Time Physical Architecture
Event Manager: Reads log information written by the consumer server. Distributes event and charges to downstream systems. Events are sent to the event store, and updated balance information is passed to the Wallet Server.
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
External Events & Authorizations
Directory Servers
CS Log
Event Manager
Event Stores (Events & Charges)
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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Figure 28

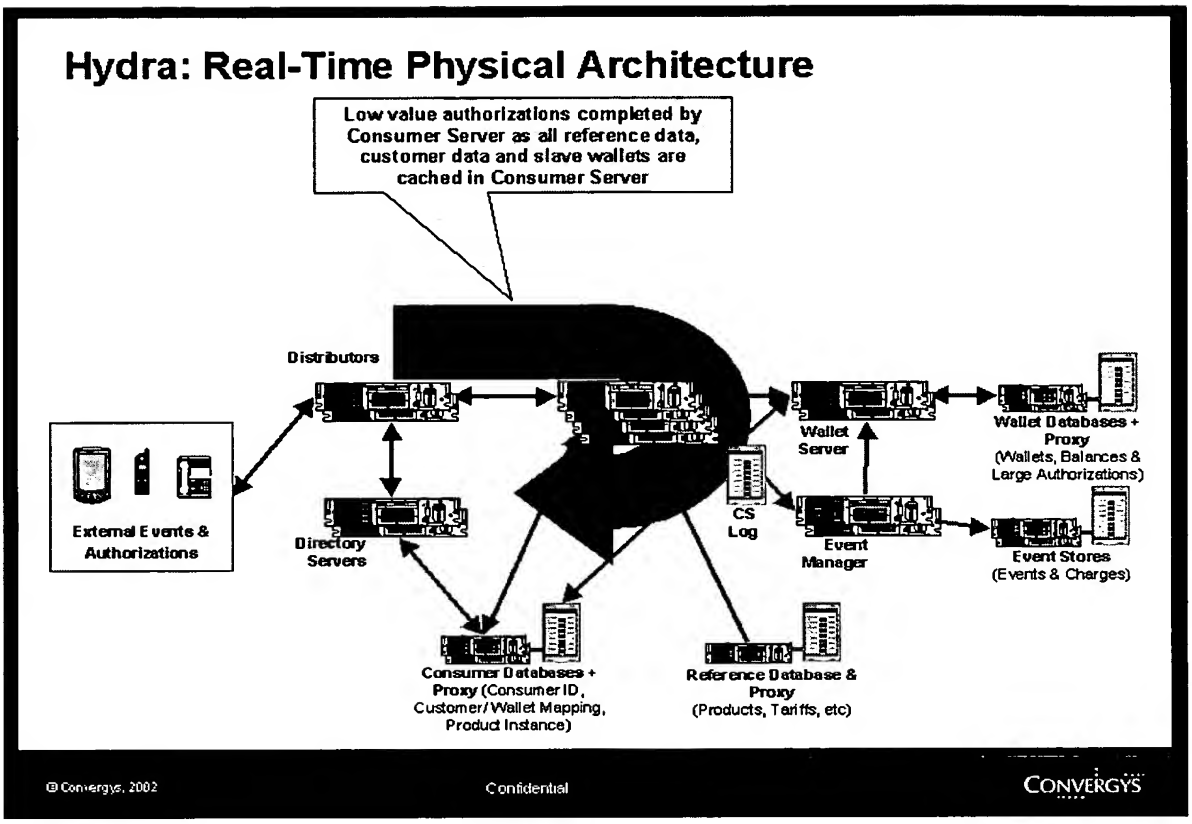
Hydra: Real-Time Physical Architecture
Low value authorizations completed by Consumer Server as all reference data, customer data and slave wallets are cached in Consumer Server
Distributors
External Events & Authorizations
Directory Servers
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
CS Log
Wallet Server
Event Manager
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
Event Stores (Events & Charges)
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Figure 29

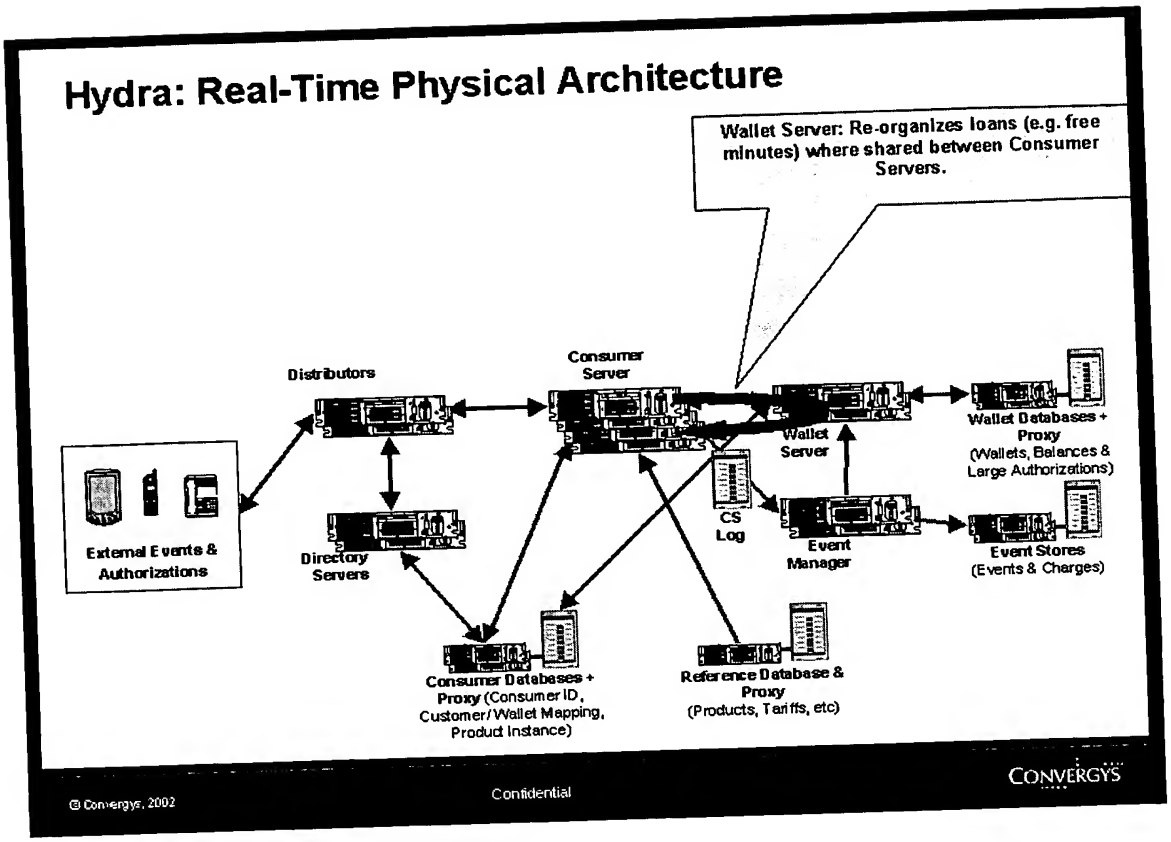
Hydra: Real-Time Physical Architecture
Wallet Server: Re-organizes loans (e.g. free minutes) where shared between Consumer Servers.
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
External Events & Authorizations
Directory Servers
CS Log
Event Manager
Event Stores (Events & Charges)
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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Figure 30

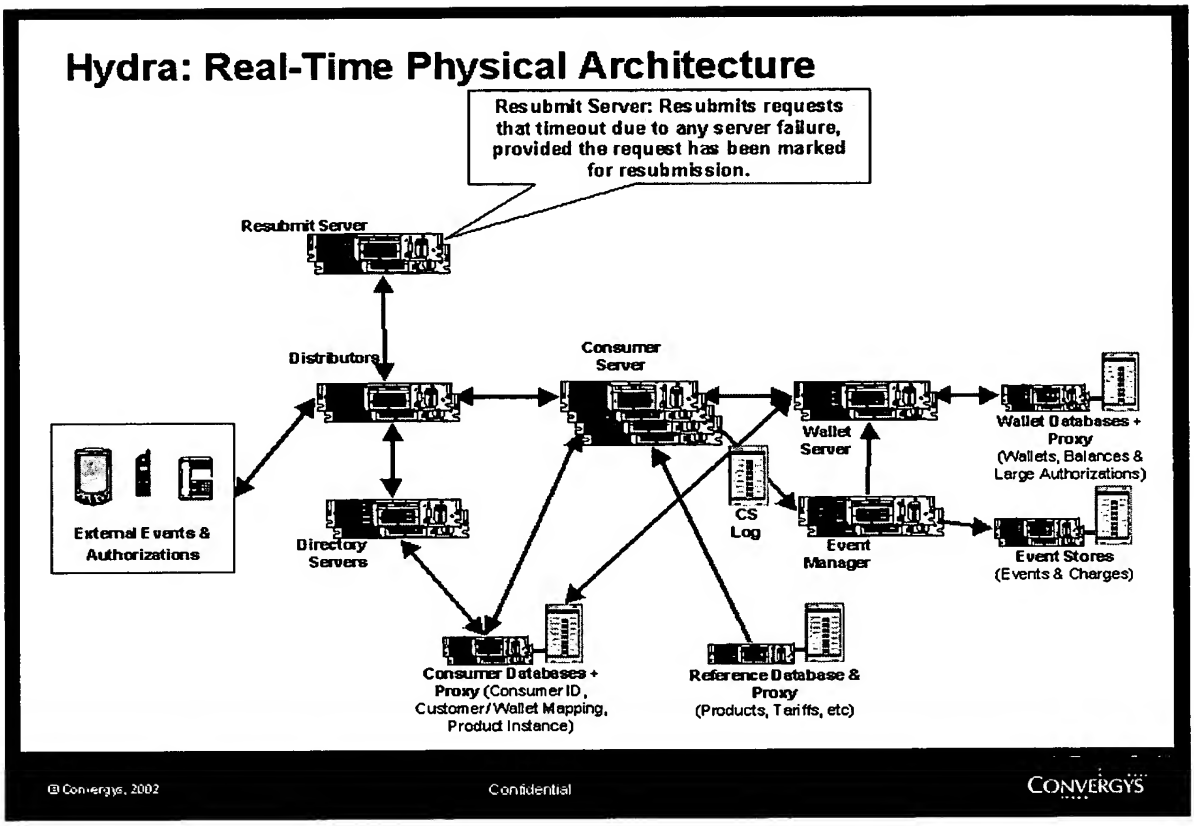
Hydra: Real-Time Physical Architecture
Resubmit Server: Resubmits requests that timeout due to any server failure, provided the request has been marked for resubmission.
Resubmit Server
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
External Events & Authorizations
Directory Servers
CS Log
Event Manager
Event Stores (Events & Charges)
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
© Convergys, 2002
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Figure 31

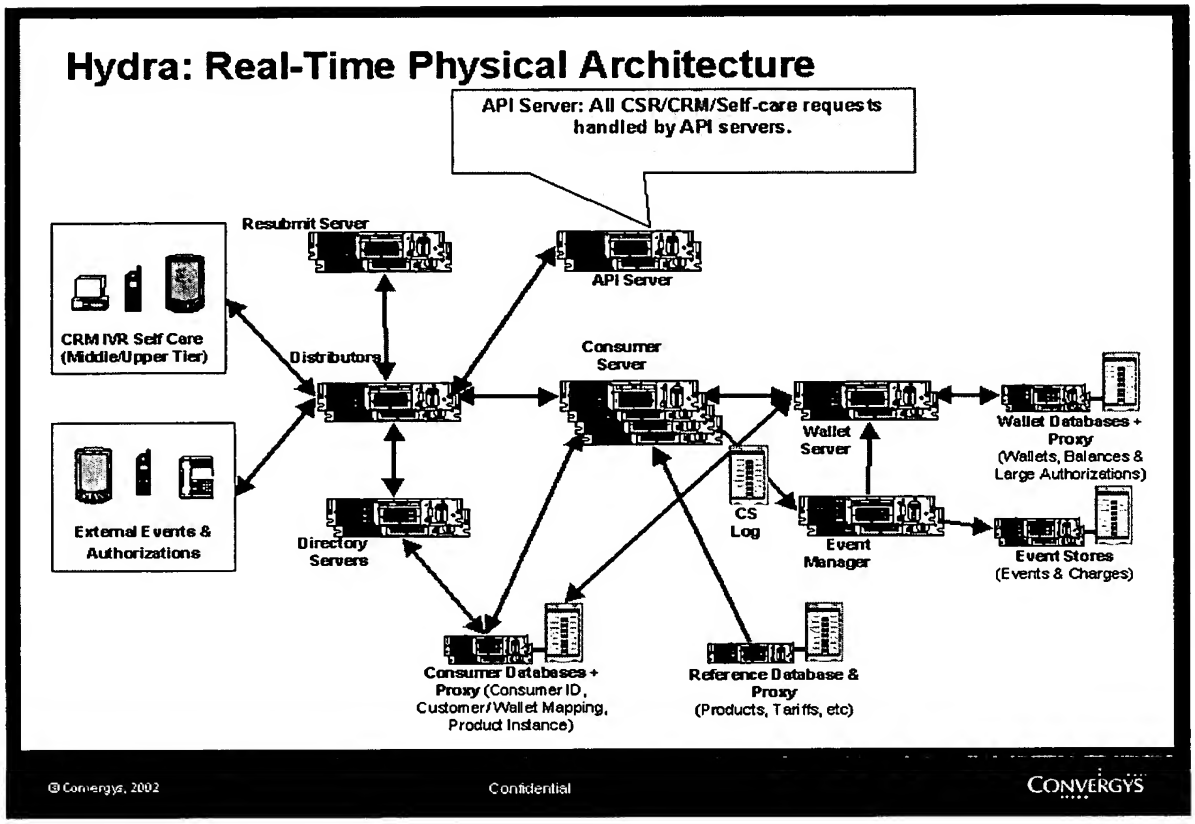
Hydra: Real-Time Physical Architecture
API Server: All CSR/CRM/Self-care requests handled by API servers.
Resubmit Server
API Server
CRM IVR Self Care (Middle/Upper Tier)
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
External Events & Authorizations
Directory Servers
CS Log
Event Manager
Event Stores (Events & Charges)
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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Figure 32

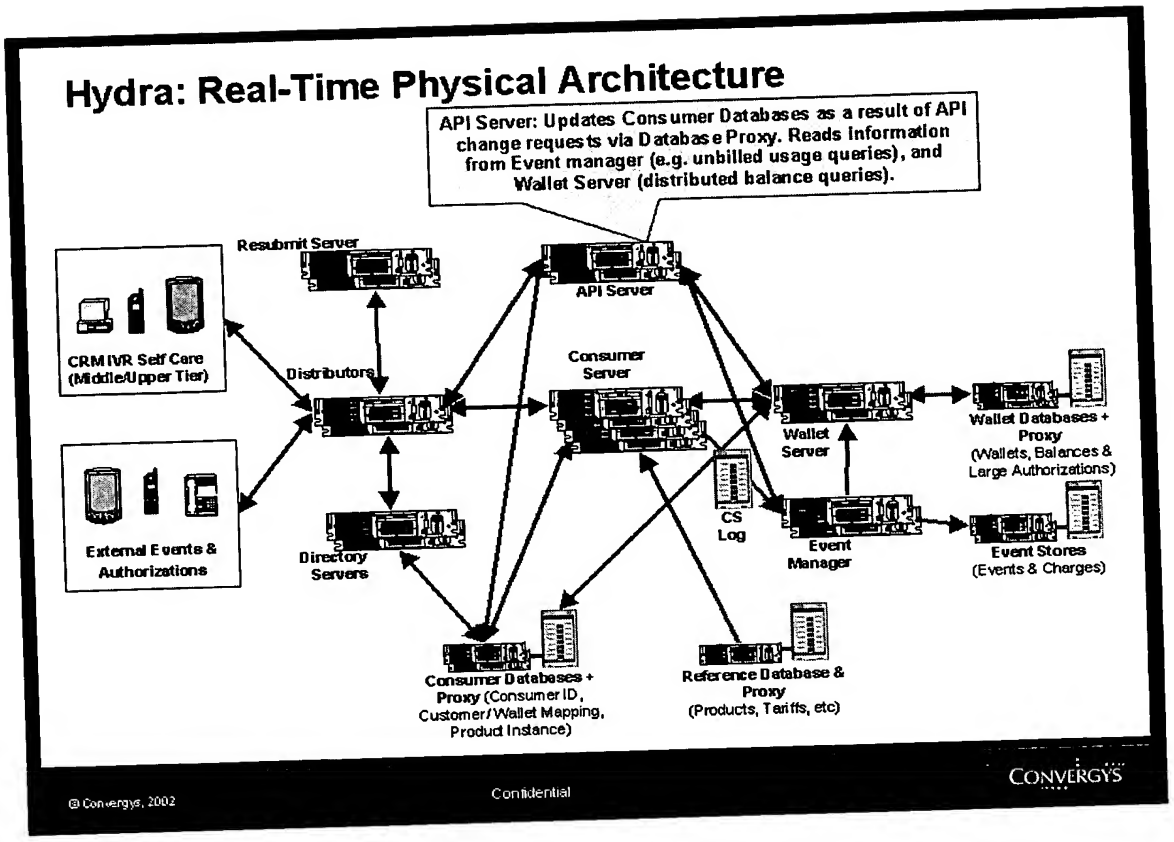
Hydra: Real-Time Physical Architecture
API Server: Updates Consumer Databases as a result of API change requests via Database Proxy. Reads Information from Event manager (e.g. unbilled usage queries), and Wallet Server (distributed balance queries).
Resubmit Server
API Server
CRM IVR Self Care (Middle/Upper Tier)
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
CS Log
Event Manager
Event Stores (Events & Charges)
External Events & Authorizations
Directory Servers
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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Figure 33

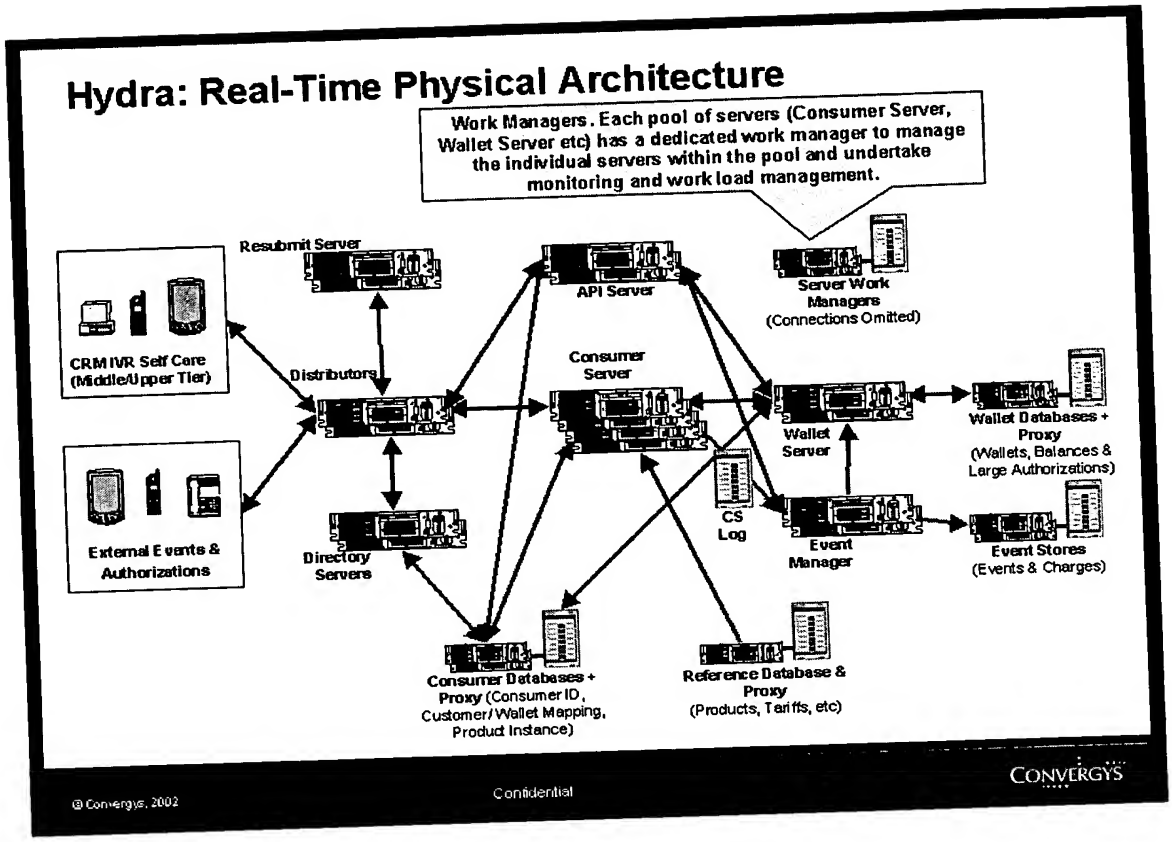
Hydra: Real-Time Physical Architecture
Work Managers. Each pool of servers (Consumer Server, Wallet Server etc) has a dedicated work manager to manage the individual servers within the pool and undertake monitoring and work load management.
Resubmit Server
API Server
Server Work Managers (Connections Omitted)
CRM IVR Self Care (Middle/Upper Tier)
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
External Events & Authorizations
Directory Servers
CS Log
Event Manager
Event Stores (Events & Charges)
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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Figure 34

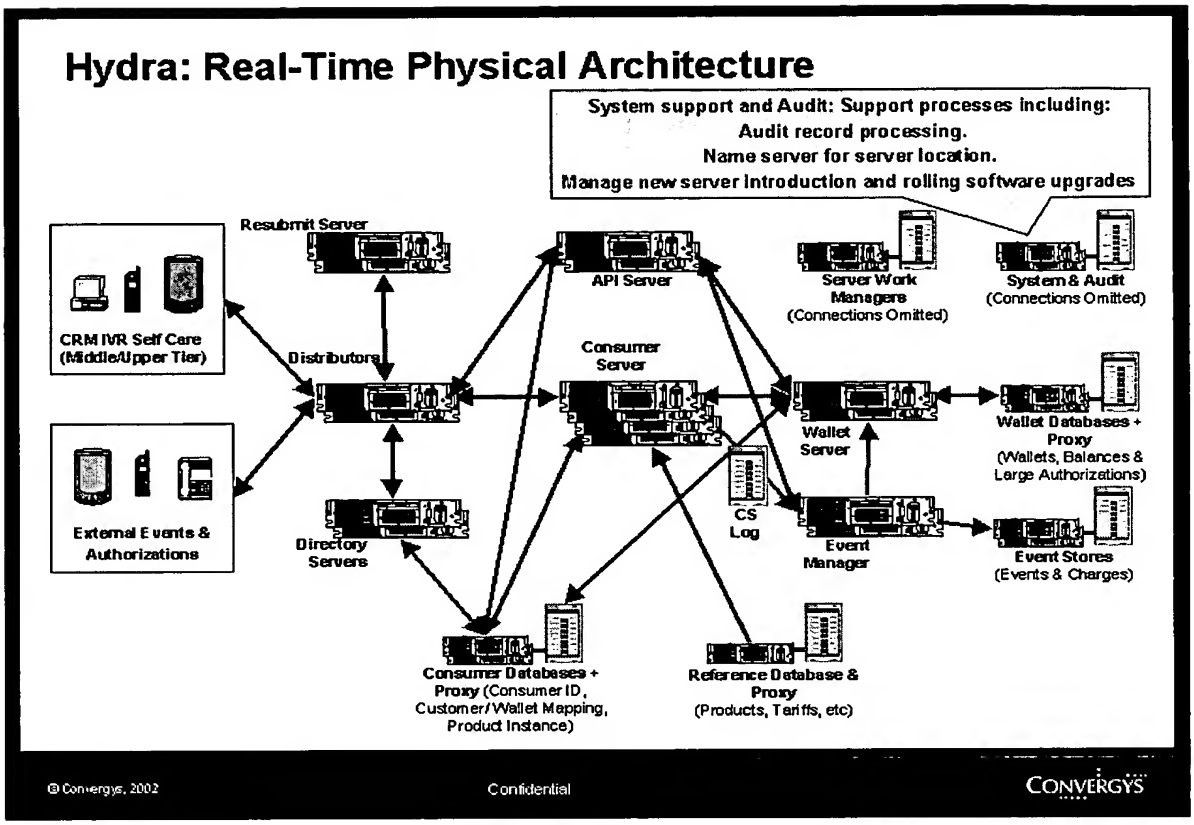
Hydra: Real-Time Physical Architecture
System support and Audit: Support processes including:
Audit record processing.
Name server for server location.
Manage new server introduction and rolling software upgrades
Resubmit Server
API Server
Server Work Managers (Connections Omitted)
System & Audit (Connections Omitted)
CRM IVR Self Care (Middle/Upper Tier)
Distributors
Consumer Server
Wallet Server
Wallet Databases + Proxy (Wallets, Balances & Large Authorizations)
External Events & Authorizations
Directory Servers
CS Log
Event Manager
Event Stores (Events & Charges)
Consumer Databases + Proxy (Consumer ID, Customer/Wallet Mapping, Product Instance)
Reference Database & Proxy (Products, Tariffs, etc)
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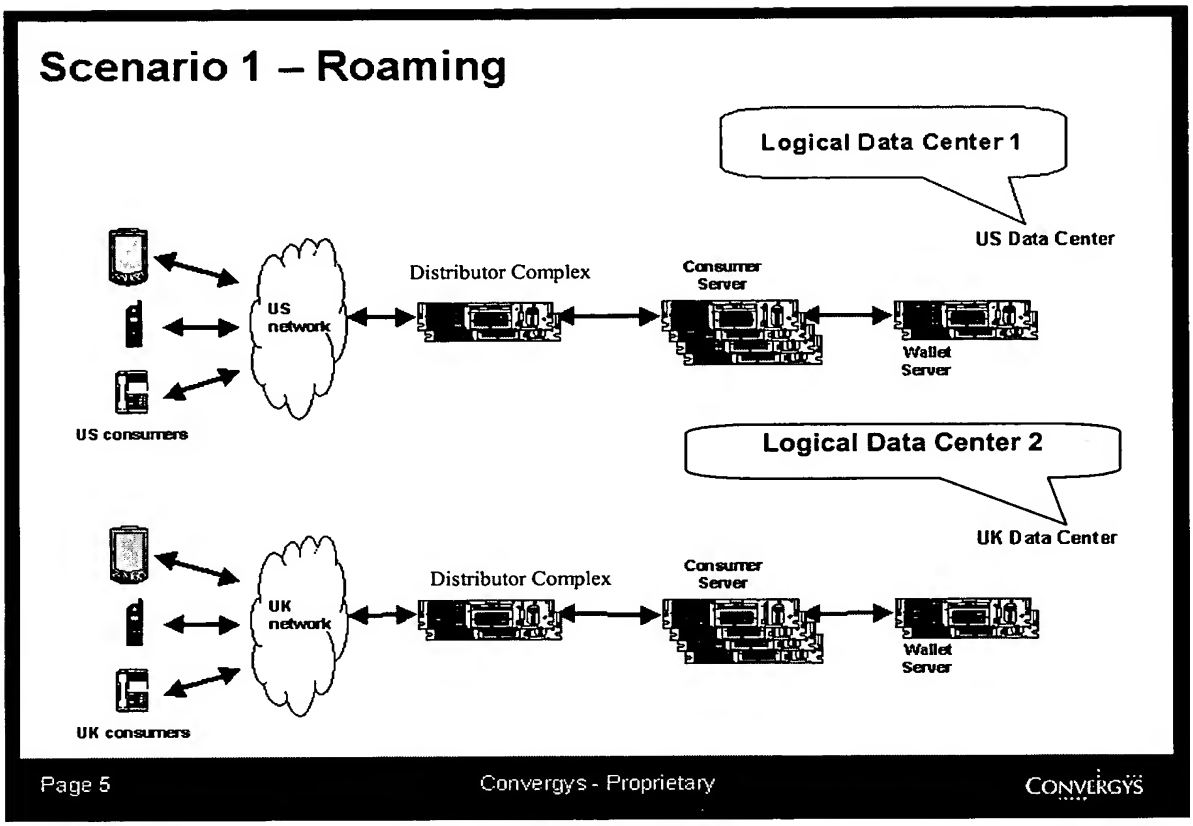
Figure 35


Scenario 1 – Roaming
Logical Data Center 1
US Data Center
Distributor Complex
Consumer Server
US network
Wallet Server
US consumers
Logical Data Center 2
UK Data Center
Distributor Complex
Consumer Server
UK network
Wallet Server
UK consumers
Page 5
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CONVERGYS

Figure 36

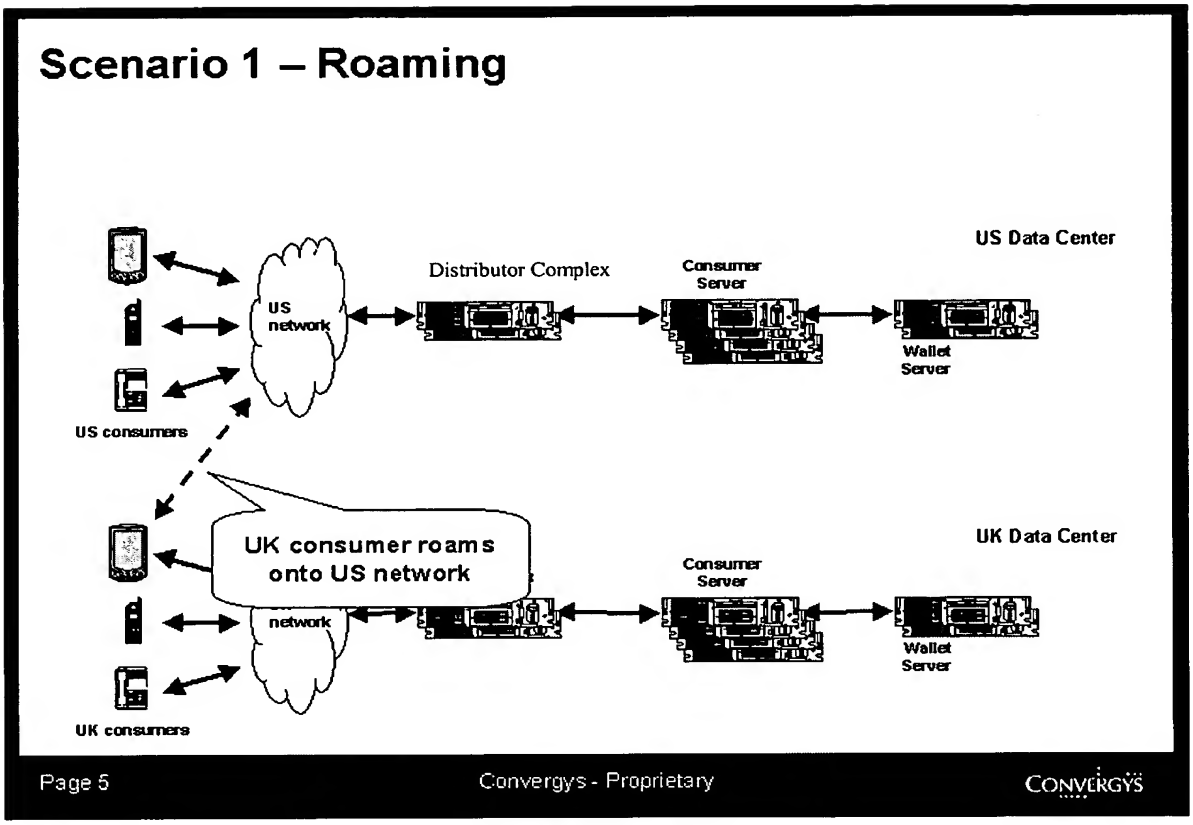
Scenario 1 – Roaming
US Data Center
Distributor Complex
Consumer Server
US network
Wallet Server
US consumers
UK consumer roams onto US network
UK Data Center
Consumer Server
network
Wallet Server
UK consumers
Page 5
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Figure 37

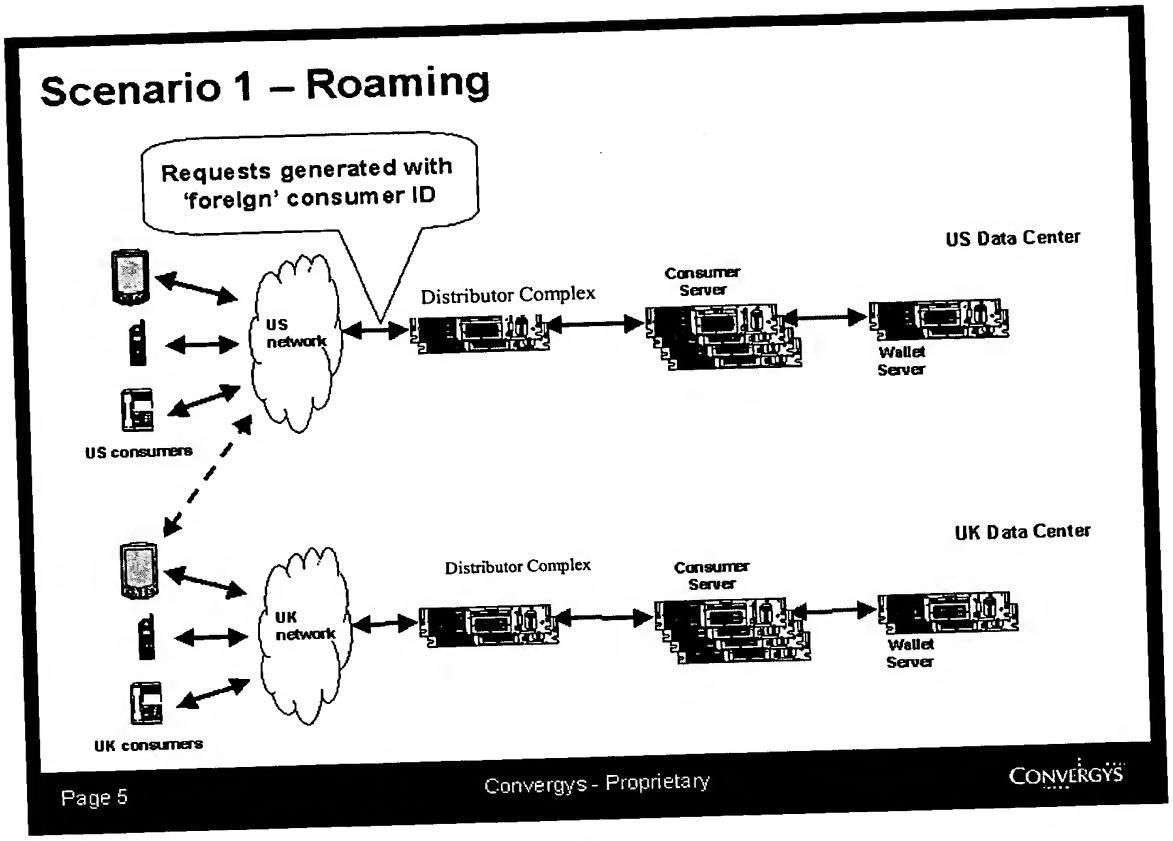
Scenario 1 – Roaming
Requests generated with 'foreign' consumer ID
US Data Center
Distributor Complex
Consumer Server
US network
Wallet Server
US consumers
UK Data Center
Distributor Complex
Consumer Server
UK network
Wallet Server
UK consumers
Page 5
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Figure 38

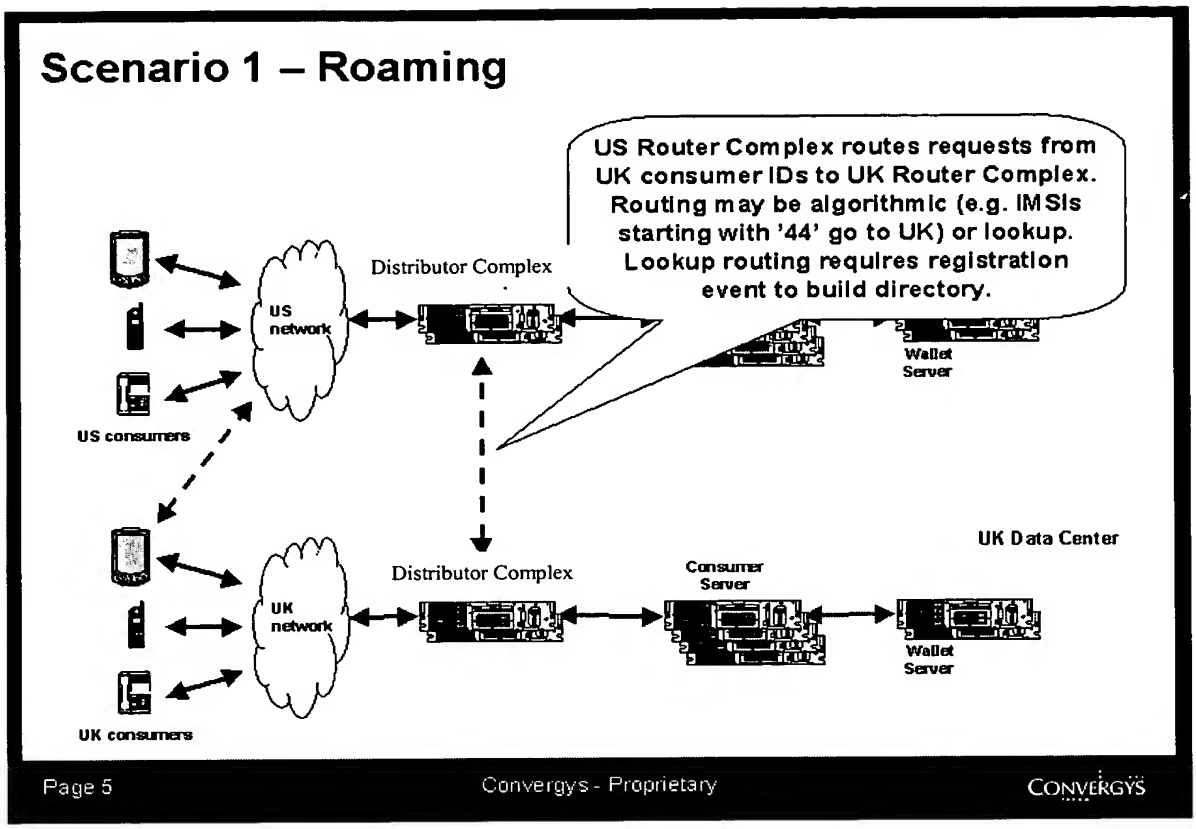
Scenario 1 – Roaming
US Router Complex routes requests from UK consumer IDs to UK Router Complex. Routing may be algorithmic (e.g. IMSIs starting with '44' go to UK) or lookup. Lookup routing requires registration event to build directory.
Distributor Complex
US network
US consumers
Wallet Server
UK Data Center
Distributor Complex
Consumer Server
UK network
Wallet Server
UK consumers
Page 5
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Figure 39

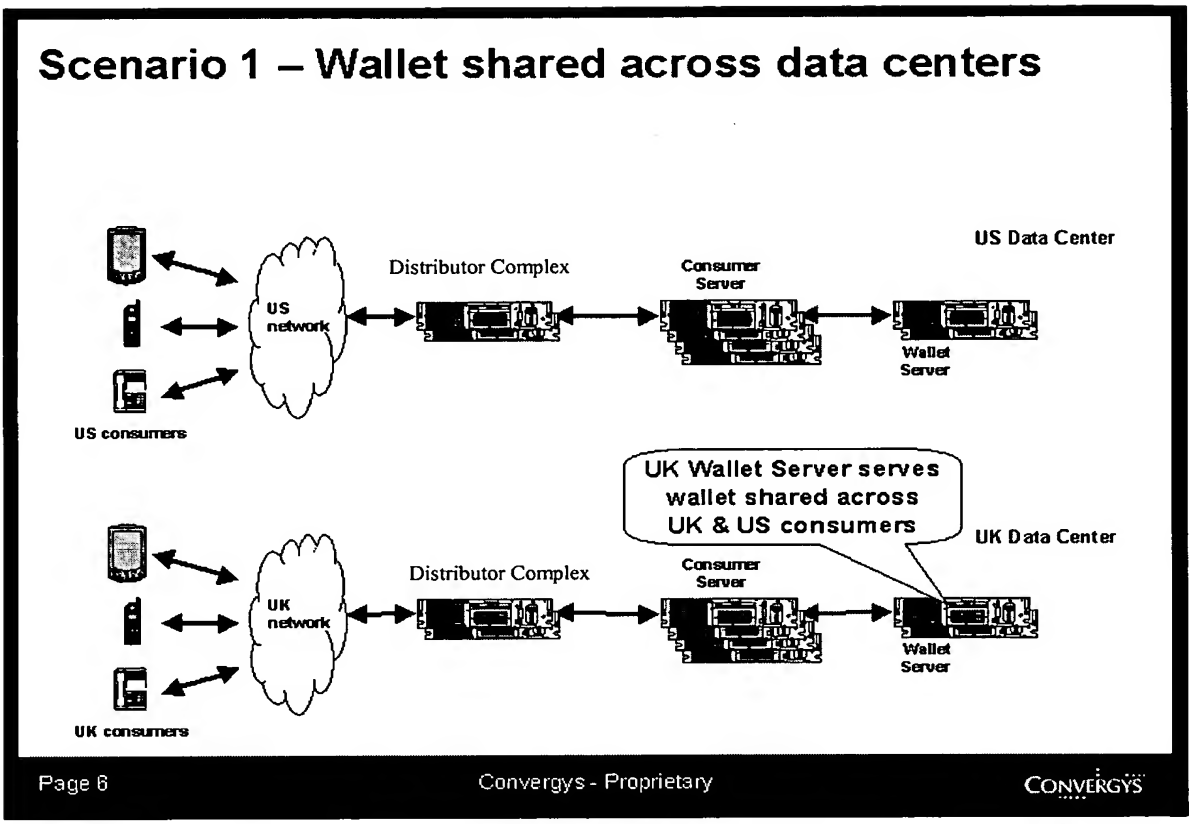
Scenario 1 – Wallet shared across data centers
US Data Center
Distributor Complex
Consumer Server
US network
Wallet Server
US consumers
UK Wallet Server serves wallet shared across UK & US consumers
UK Data Center
Distributor Complex
Consumer Server
UK network
Wallet Server
UK consumers
Page 6
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Figure 40

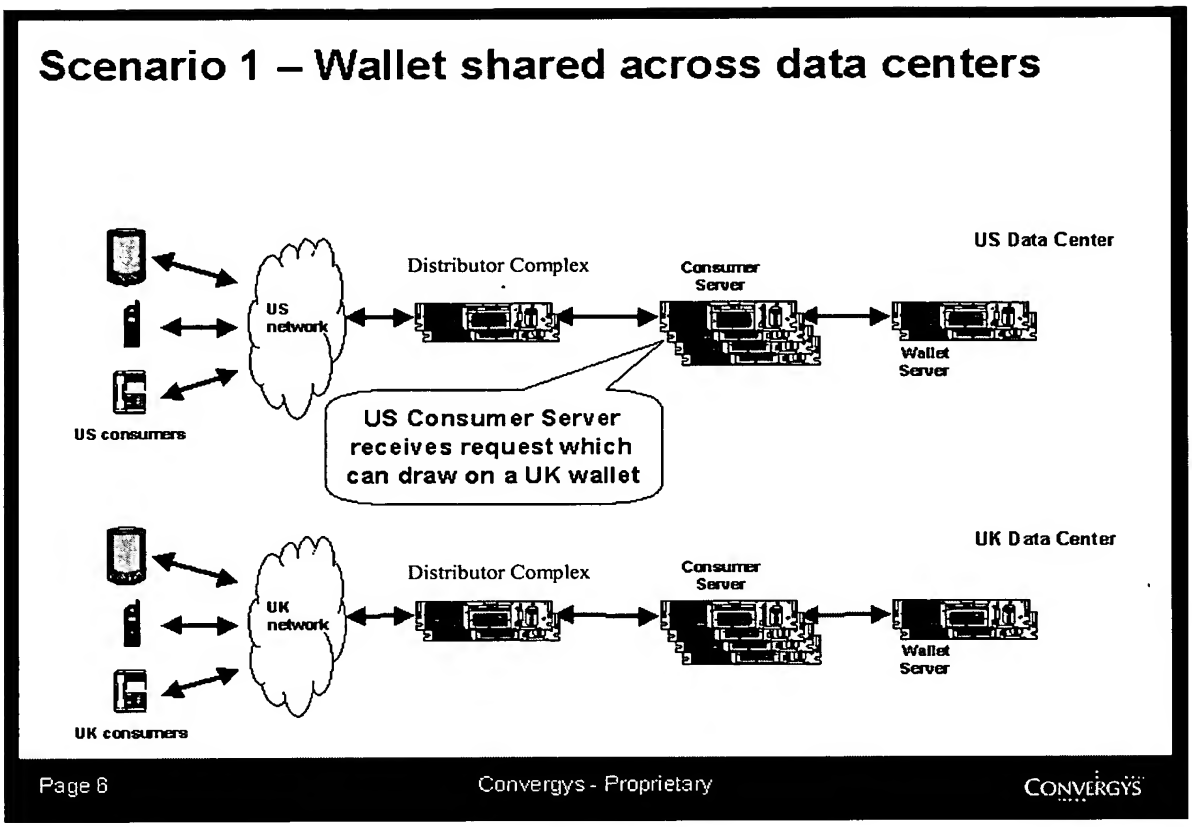
Scenario 1 – Wallet shared across data centers
US Data Center
Distributor Complex
Consumer Server
US network
Wallet Server
US consumers
US Consumer Server receives request which can draw on a UK wallet
UK Data Center
Distributor Complex
Consumer Server
UK network
Wallet Server
UK consumers
Page 8
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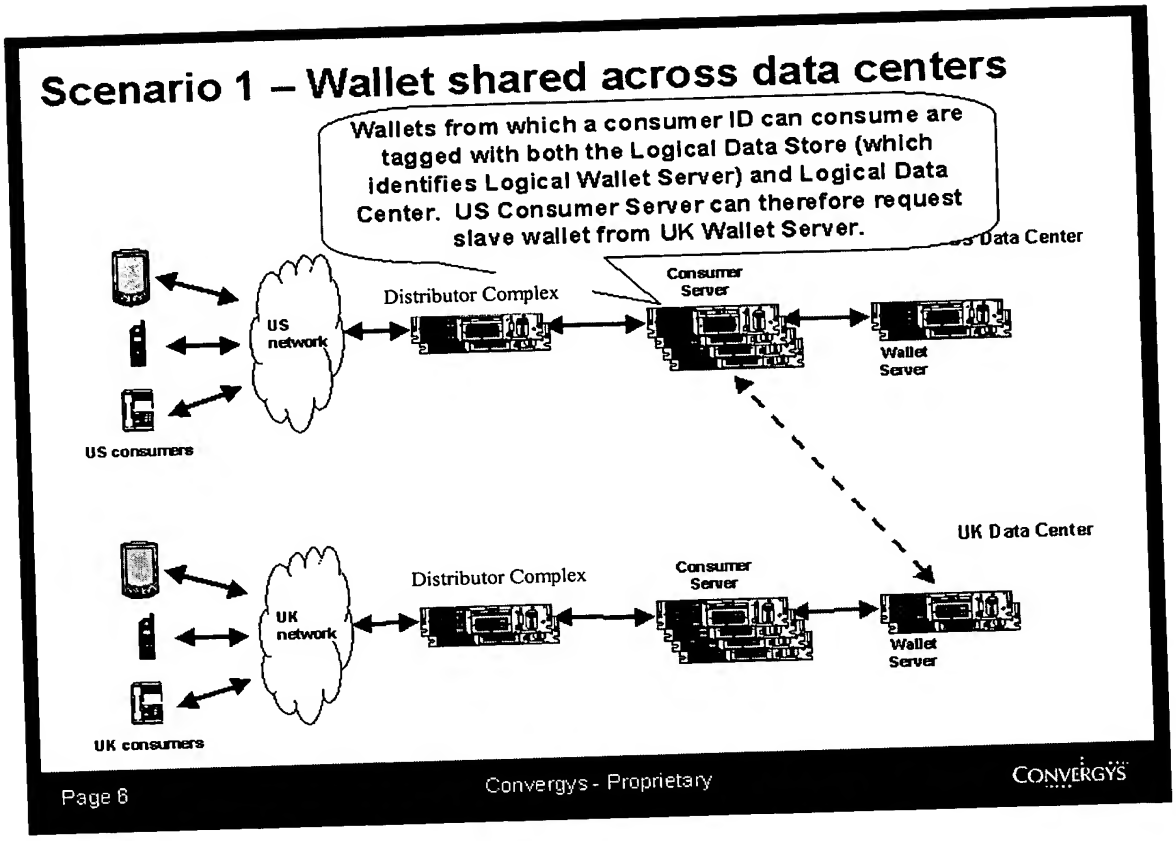
Figure 41


Scenario 1 – Wallet shared across data centers
Wallets from which a consumer ID can consume are tagged with both the Logical Data Store (which identifies Logical Wallet Server) and Logical Data Center. US Consumer Server can therefore request slave wallet from UK Wallet Server.
Data Center
Consumer Server
Distributor Complex
US network
Wallet Server
US consumers
UK Data Center
Distributor Complex
Consumer Server
UK network
Wallet Server
UK consumers
Page 6
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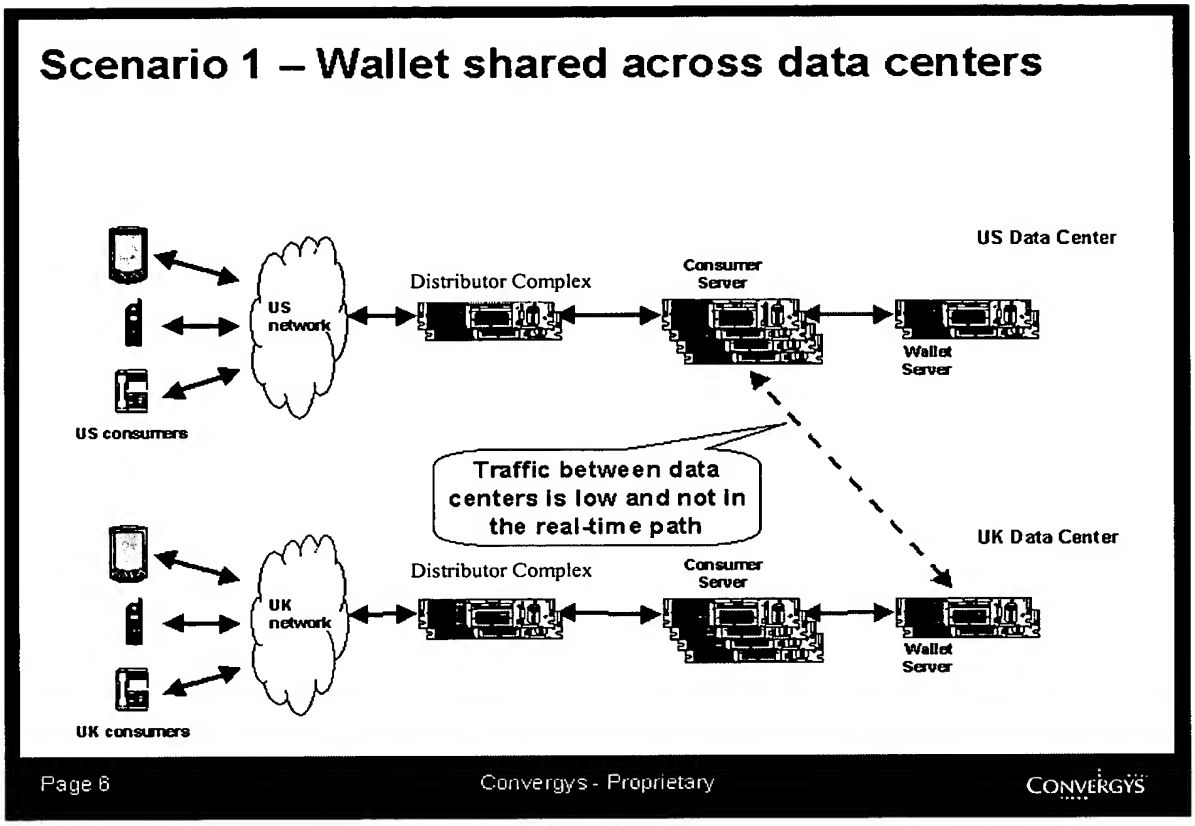
CONVERGYS

Figure 42


Scenario 1 – Wallet shared across data centers
US Data Center
Distributor Complex
Consumer Server
US network
Wallet Server
US consumers
Traffic between data centers is low and not in the real-time path
UK Data Center
Distributor Complex
Consumer Server
UK network
Wallet Server
UK consumers
Page 6
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CONVERGYS

Figure 43

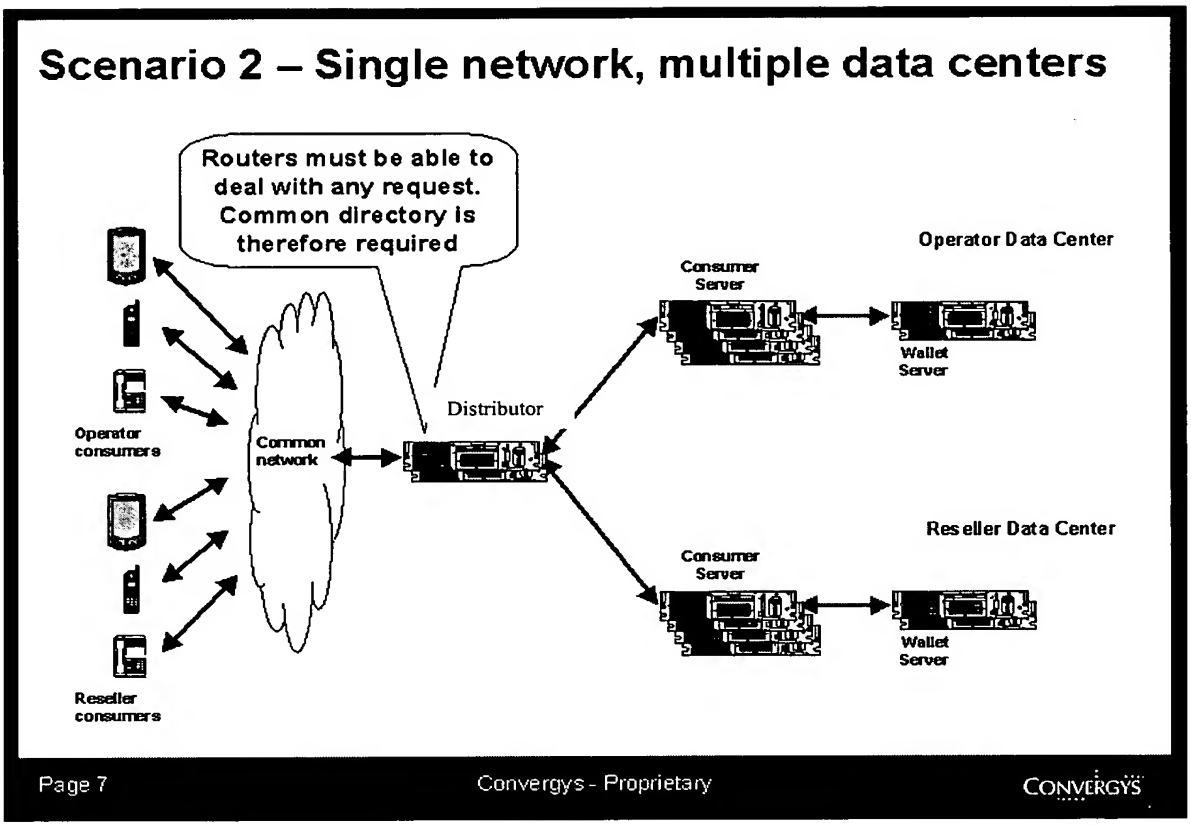
Scenario 2 – Single network, multiple data centers
Routers must be able to deal with any request. Common directory is therefore required
Operator Data Center
Consumer Server
Wallet Server
Distributor
Operator consumers
Common network
Reseller Data Center
Consumer Server
Wallet Server
Reseller consumers
Page 7
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Figure 44

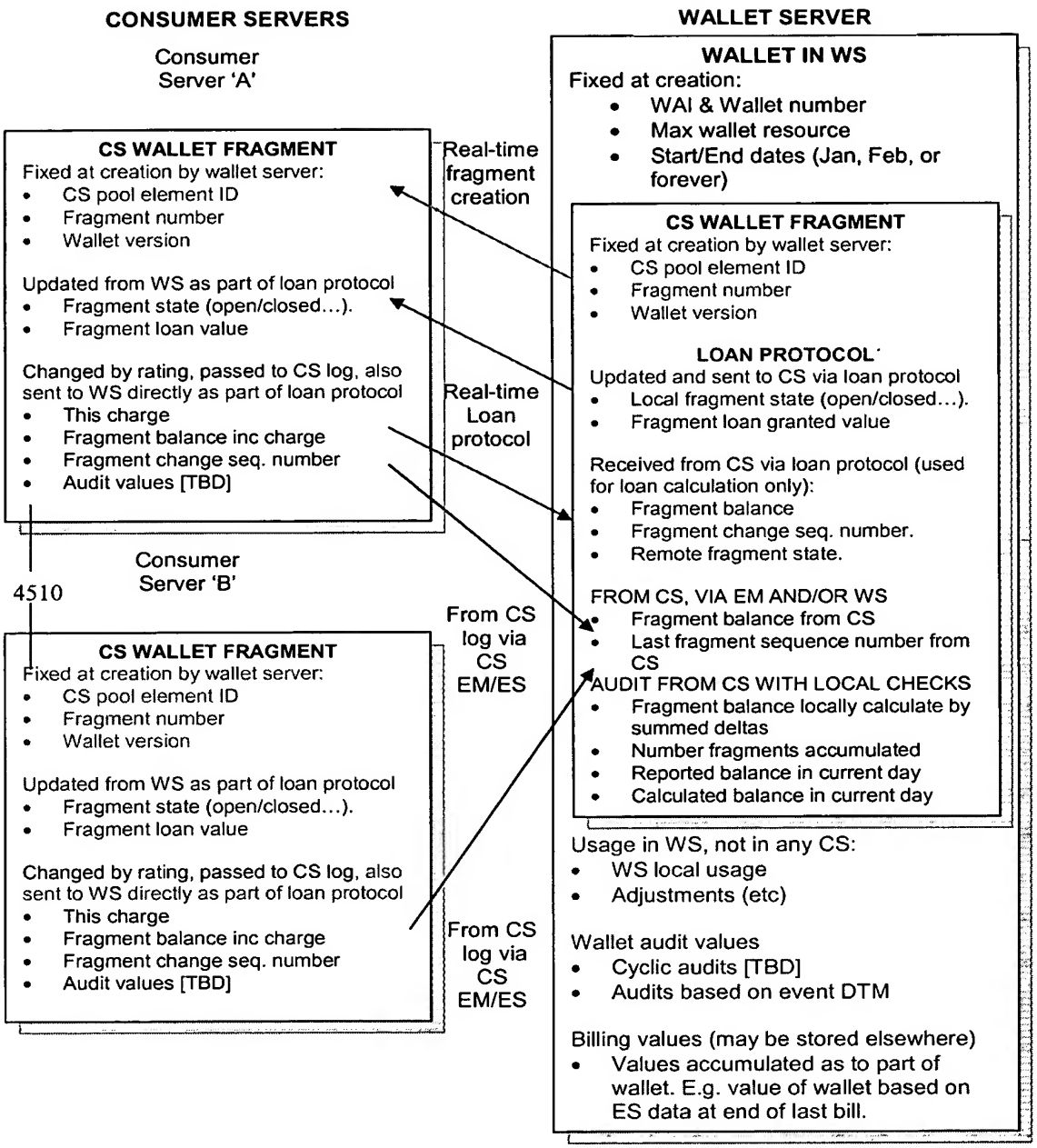
CONSUMER SERVERS
WALLET SERVER
Consumer Server 'A'
WALLET IN WS
Fixed at creation:
• WAI & Wallet number
• Max wallet resource
• Start/End dates (Jan, Feb, or forever)
CS WALLET FRAGMENT
Fixed at creation by wallet server:
• CS pool element ID
• Fragment number
• Wallet version
Updated from WS as part of loan protocol
• Fragment state (open/closed...).
• Fragment loan value
Changed by rating, passed to CS log, also sent to WS directly as part of loan protocol
• This charge
• Fragment balance inc charge
• Fragment change seq. number
• Audit values [TBD]
Real-time fragment creation
Real-time Loan protocol
CS WALLET FRAGMENT
Fixed at creation by wallet server:
• CS pool element ID
• Fragment number
• Wallet version
LOAN PROTOCOL
Updated and sent to CS via loan protocol
• Local fragment state (open/closed...).
• Fragment loan granted value
Received from CS via loan protocol (used for loan calculation only):
• Fragment balance
• Fragment change seq. number.
• Remote fragment state.
FROM CS, VIA EM AND/OR WS
• Fragment balance from CS
• Last fragment sequence number from CS
AUDIT FROM CS WITH LOCAL CHECKS
• Fragment balance locally calculate by summed deltas
• Number fragments accumulated
• Reported balance in current day
• Calculated balance in current day
Consumer Server 'B'
4510
From CS log via CS EM/ES
CS WALLET FRAGMENT
Fixed at creation by wallet server:
• CS pool element ID
• Fragment number
• Wallet version
Updated from WS as part of loan protocol
• Fragment state (open/closed...).
• Fragment loan value
Changed by rating, passed to CS log, also sent to WS directly as part of loan protocol
• This charge
• Fragment balance inc charge
• Fragment change seq. number
• Audit values [TBD]
From CS log via CS EM/ES
Usage in WS, not in any CS:
• WS local usage
• Adjustments (etc)
Wallet audit values
• Cyclic audits [TBD]
• Audits based on event DTM
Billing values (may be stored elsewhere)
• Values accumulated as to part of wallet. E.g. value of wallet based on ES data at end of last bill.

Figure 45A

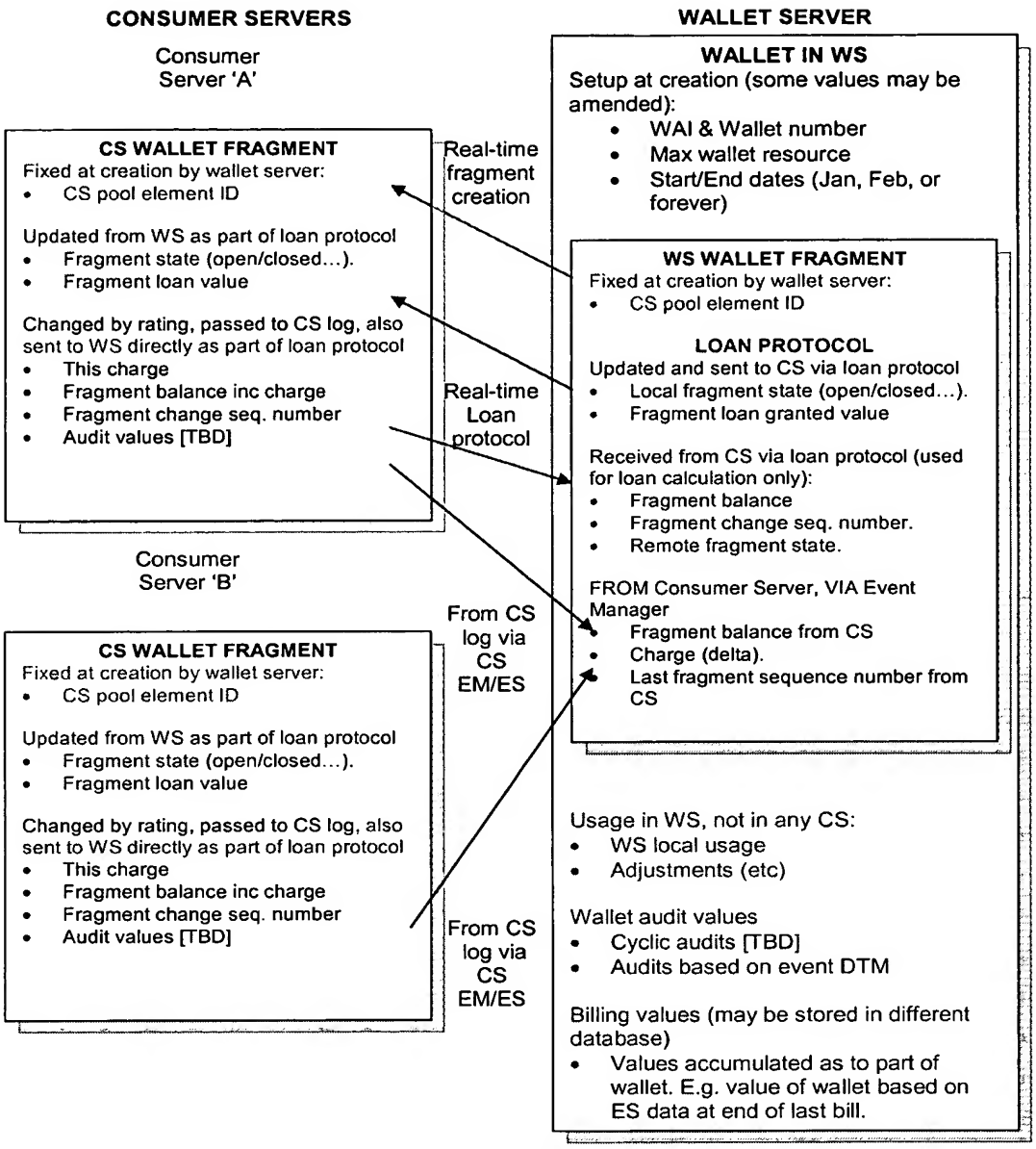
CONSUMER SERVERS
WALLET SERVER
Consumer Server 'A'
CS WALLET FRAGMENT
Fixed at creation by wallet server:
• CS pool element ID
Updated from WS as part of loan protocol
• Fragment state (open/closed...).
• Fragment loan value
Changed by rating, passed to CS log, also sent to WS directly as part of loan protocol
• This charge
• Fragment balance inc charge
• Fragment change seq. number
• Audit values [TBD]
Real-time fragment creation
Real-time Loan protocol
Consumer Server 'B'
CS WALLET FRAGMENT
Fixed at creation by wallet server:
• CS pool element ID
Updated from WS as part of loan protocol
• Fragment state (open/closed...).
• Fragment loan value
Changed by rating, passed to CS log, also sent to WS directly as part of loan protocol
• This charge
• Fragment balance inc charge
• Fragment change seq. number
• Audit values [TBD]
From CS log via CS EM/ES
From CS log via CS EM/ES
WALLET IN WS
Setup at creation (some values may be amended):
• WAI & Wallet number
• Max wallet resource
• Start/End dates (Jan, Feb, or forever)
WS WALLET FRAGMENT
Fixed at creation by wallet server:
• CS pool element ID
LOAN PROTOCOL
Updated and sent to CS via loan protocol
• Local fragment state (open/closed...).
• Fragment loan granted value
Received from CS via loan protocol (used for loan calculation only):
• Fragment balance
• Fragment change seq. number.
• Remote fragment state.
FROM Consumer Server, VIA Event Manager
• Fragment balance from CS
• Charge (delta).
• Last fragment sequence number from CS
Usage in WS, not in any CS:
• WS local usage
• Adjustments (etc)
Wallet audit values
• Cyclic audits [TBD]
• Audits based on event DTM
Billing values (may be stored in different database)
• Values accumulated as to part of wallet. E.g. value of wallet based on ES data at end of last bill.

Figure 45B

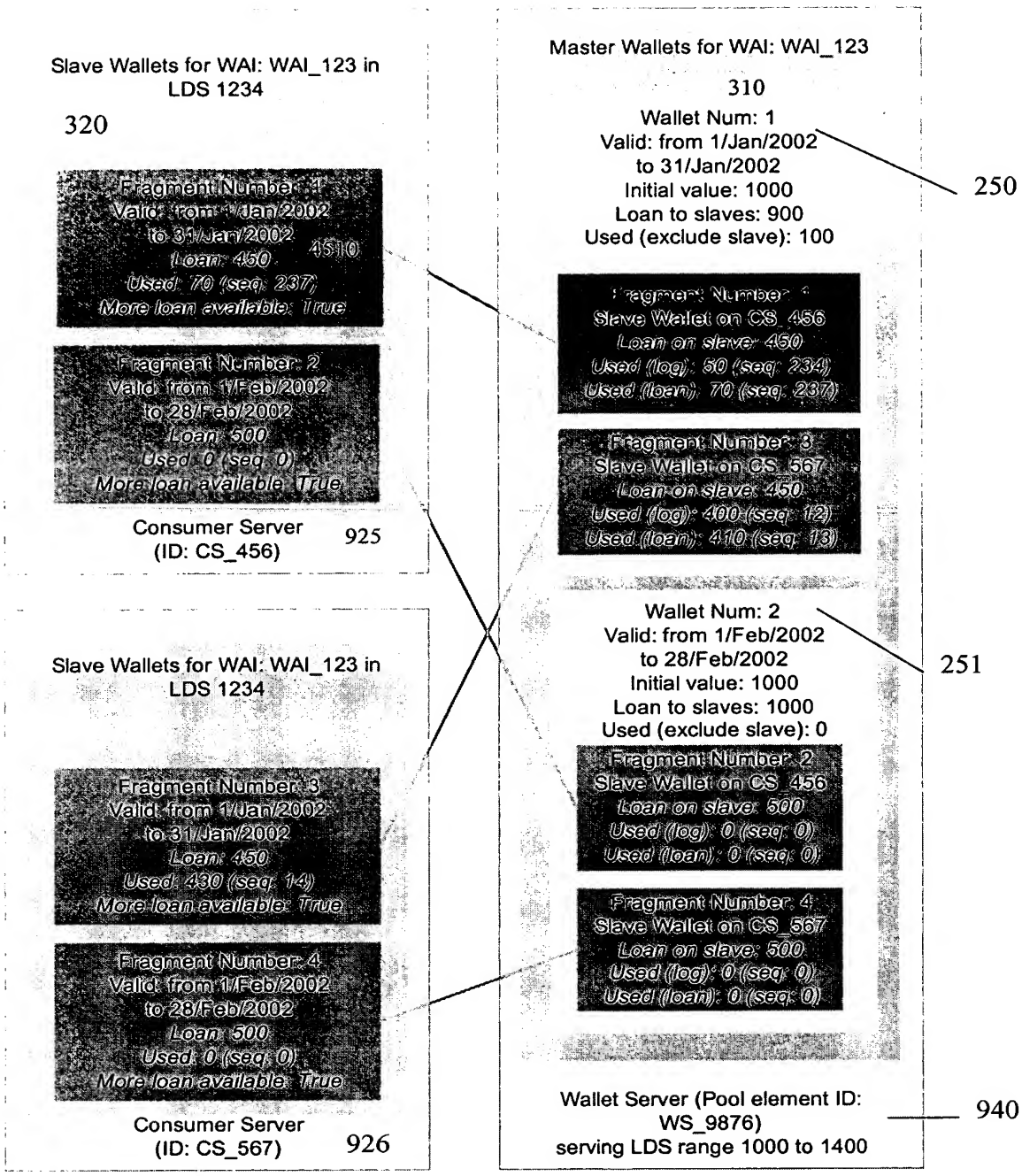
Slave Wallets for WAI: WAI_123 in LDS 1234
320
Fragment Number: 1
Valid: from 1/Jan/2002
to 31/Jan/2002
Loan: 450
Used: 70 (seq: 237)
More loan available: True
4510
Fragment Number: 2
Valid: from 1/Feb/2002
to 28/Feb/2002
Loan: 500
Used: 0 (seq: 0)
More loan available: True
Consumer Server
(ID: CS_456)
925
Slave Wallets for WAI: WAI_123 in LDS 1234
Fragment Number: 3
Valid: from 1/Jan/2002
to 31/Jan/2002
Loan: 450
Used: 430 (seq: 14)
More loan available: True
Fragment Number: 4
Valid: from 1/Feb/2002
to 28/Feb/2002
Loan: 500
Used: 0 (seq: 0)
More loan available: True
Consumer Server
(ID: CS_567)
926
Master Wallets for WAI: WAI_123
310
Wallet Num: 1
Valid: from 1/Jan/2002
to 31/Jan/2002
Initial value: 1000
Loan to slaves: 900
Used (exclude slave): 100
250
Fragment Number: 1
Slave Wallet on CS_456
Loan on slave: 450
Used (log): 50 (seq: 234)
Used (loan): 70 (seq: 237)
Fragment Number: 3
Slave Wallet on CS_567
Loan on slave: 450
Used (log): 400 (seq: 12)
Used (loan): 410 (seq: 13)
Wallet Num: 2
Valid: from 1/Feb/2002
to 28/Feb/2002
Initial value: 1000
Loan to slaves: 1000
Used (exclude slave): 0
251
Fragment Number: 2
Slave Wallet on CS_456
Loan on slave: 500
Used (log): 0 (seq: 0)
Used (loan): 0 (seq: 0)
Fragment Number: 4
Slave Wallet on CS_567
Loan on slave: 500
Used (log): 0 (seq: 0)
Used (loan): 0 (seq: 0)
Wallet Server (Pool element ID:
WS_9876)
serving LDS range 1000 to 1400
940

Figure 46A

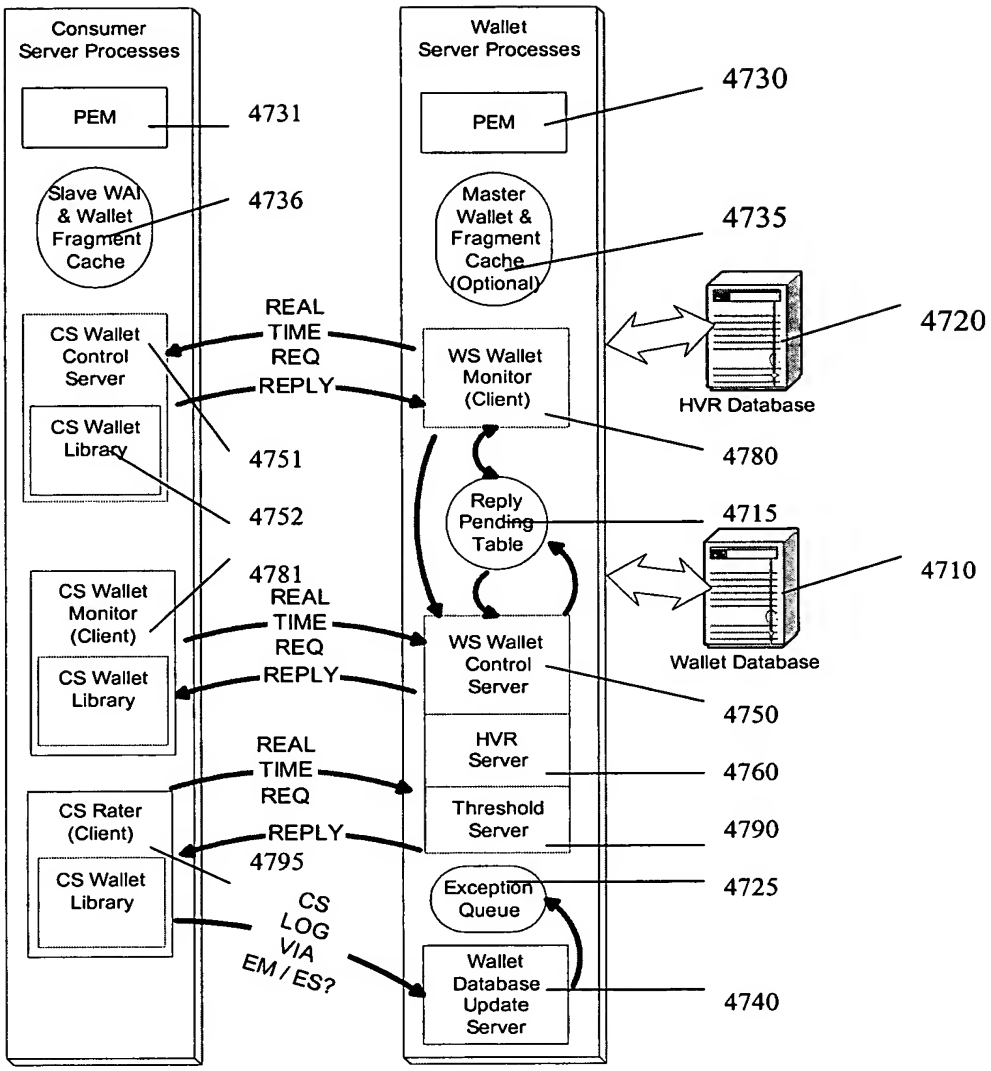
Consumer Server Processes
PEM
4731
Slave WAI & Wallet Fragment Cache
4736
CS Wallet Control Server
CS Wallet Library
4751
4752
CS Wallet Monitor (Client)
CS Wallet Library
4781
CS Rater (Client)
CS Wallet Library
4795
REAL TIME REQ
REPLY
REAL TIME REQ
REPLY
REAL TIME REQ
REPLY
CS LOG VIA EM/ES?
Wallet Server Processes
PEM
4730
Master Wallet & Fragment Cache (Optional)
4735
WS Wallet Monitor (Client)
4780
Reply Pending Table
4715
WS Wallet Control Server
4750
HVR Server
4760
Threshold Server
4790
Exception Queue
4725
Wallet Database Update Server
4740
HVR Database
4720
Wallet Database
4710

Figure 47A

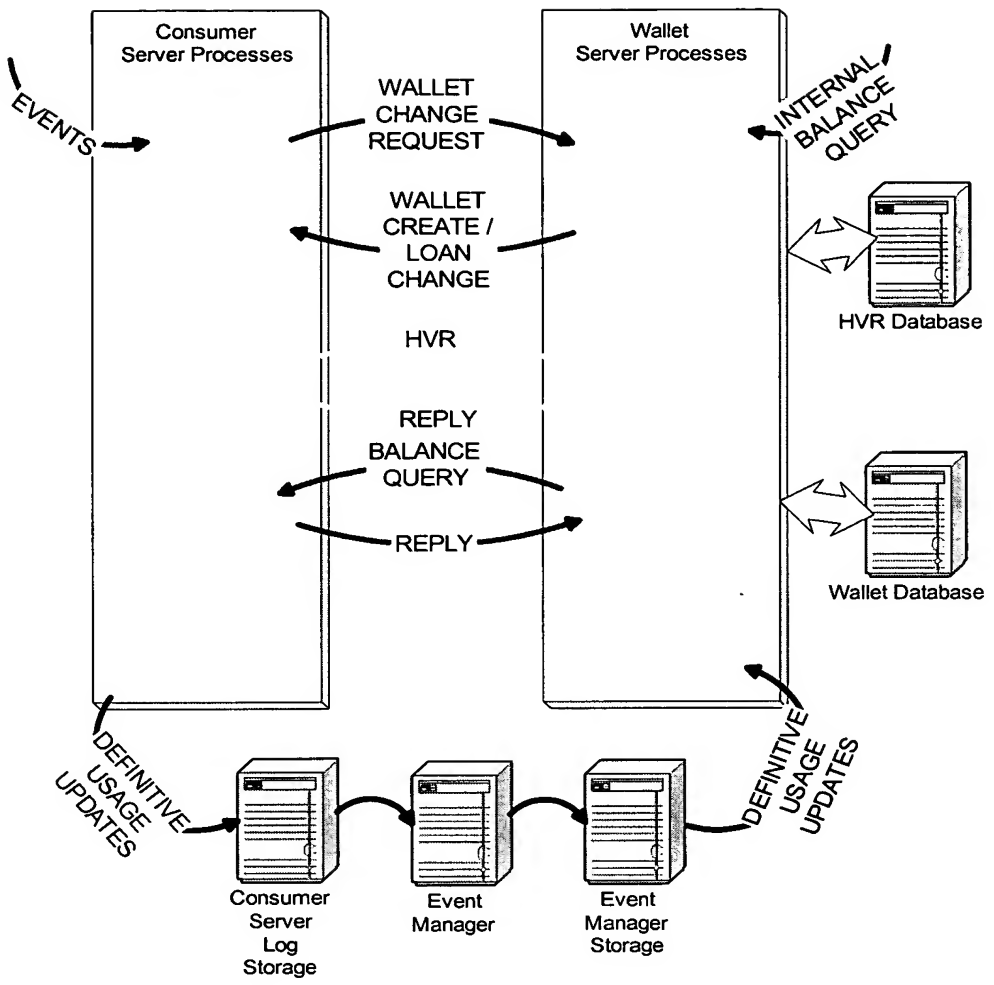
Consumer
Server Processes
Wallet
Server Processes
EVENTS
WALLET
CHANGE
REQUEST
INTERNAL
BALANCE
QUERY
WALLET
CREATE /
LOAN
CHANGE
HVR
HVR Database
REPLY
BALANCE
QUERY
REPLY
Wallet Database
DEFINITIVE
USAGE
UPDATES
DEFINITIVE
USAGE
UPDATES
Consumer
Server
Log
Storage
Event
Manager
Event
Manager
Storage

Figure 47B

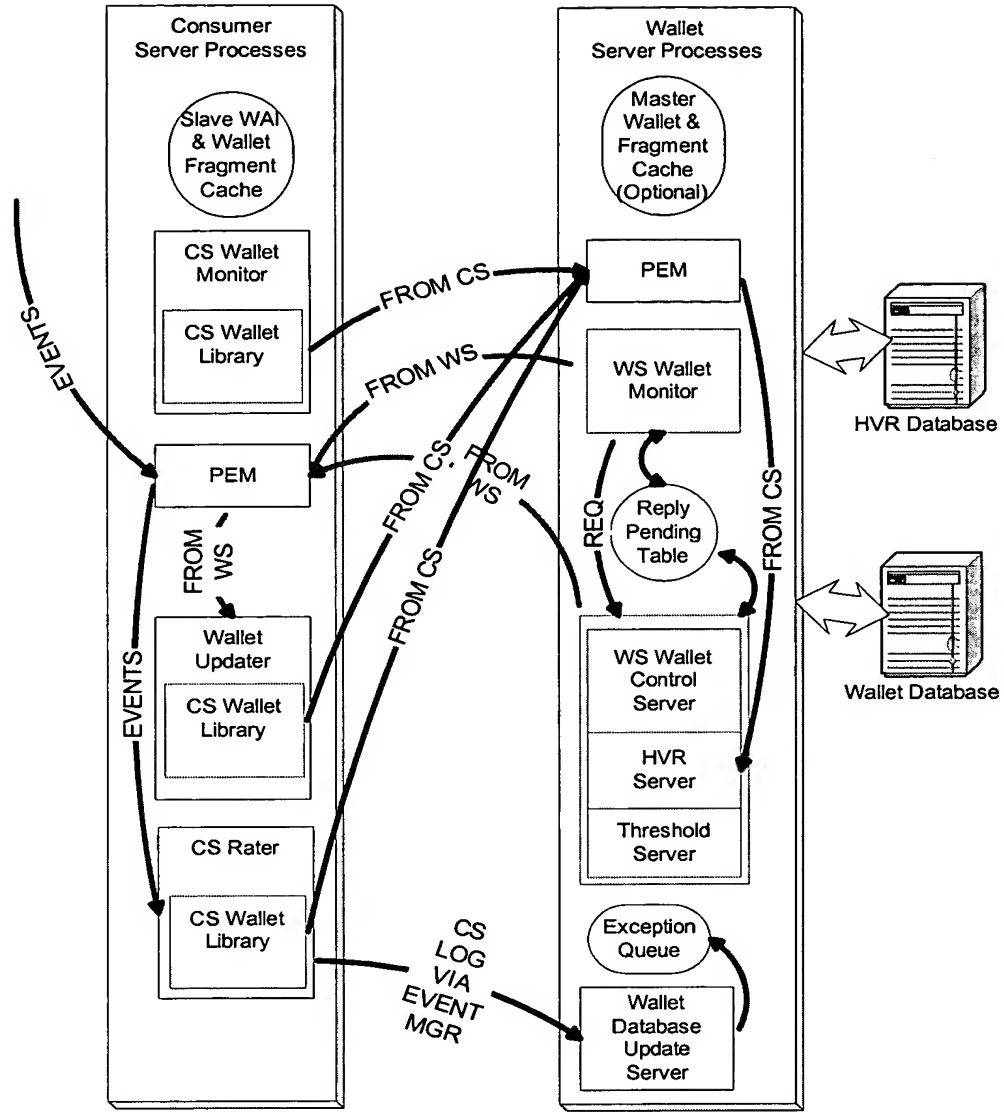
Consumer
Server Processes
Slave WAI
& Wallet
Fragment
Cache
CS Wallet
Monitor
CS Wallet
Library
PEM
Wallet
Updater
CS Wallet
Library
CS Rater
CS Wallet
Library
EVENTS
FROM
WS
EVENTS
FROM CS
FROM WS
FROM CS
FROM
WS
FROM CS
CS
LOG
VIA
EVENT
MGR
Wallet
Server Processes
Master
Wallet &
Fragment
Cache
(Optional)
PEM
WS Wallet
Monitor
REQ
Reply
Pending
Table
FROM CS
WS Wallet
Control
Server
HVR
Server
Threshold
Server
Exception
Queue
Wallet
Database
Update
Server
HVR Database
Wallet Database

Figure 47C

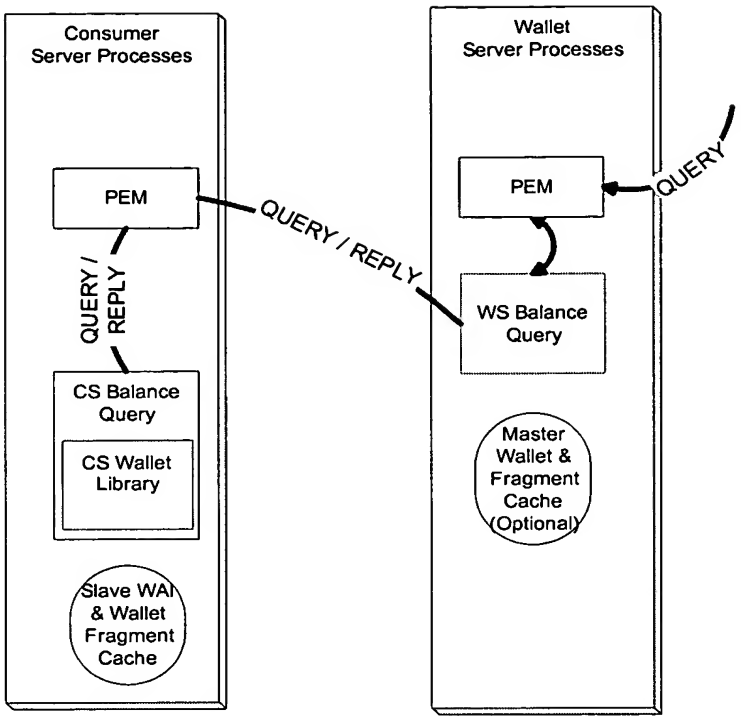
Consumer
Server Processes
PEM
QUERY / REPLY
CS Balance
Query
CS Wallet
Library
Slave WAI
& Wallet
Fragment
Cache
Wallet
Server Processes
PEM
QUERY
WS Balance
Query
Master
Wallet &
Fragment
Cache
(Optional)

Figure 47D

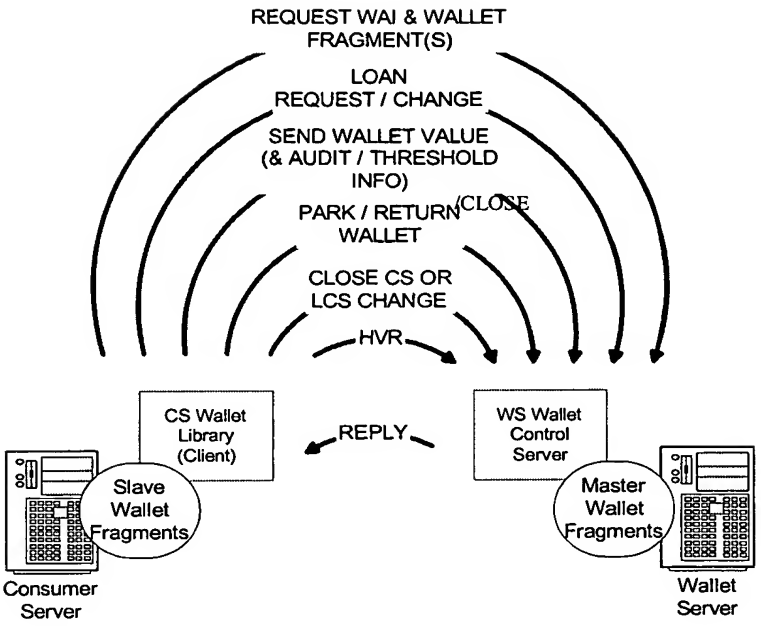
REQUEST WAI & WALLET FRAGMENT(S)
LOAN REQUEST / CHANGE
SEND WALLET VALUE (& AUDIT / THRESHOLD INFO)
PARK / RETURN WALLET
(CLOSE
CLOSE CS OR LCS CHANGE
HVR
CS Wallet Library (Client)
REPLY
WS Wallet Control Server
Slave Wallet Fragments
Master Wallet Fragments
Consumer Server
Wallet Server

Figure 48A

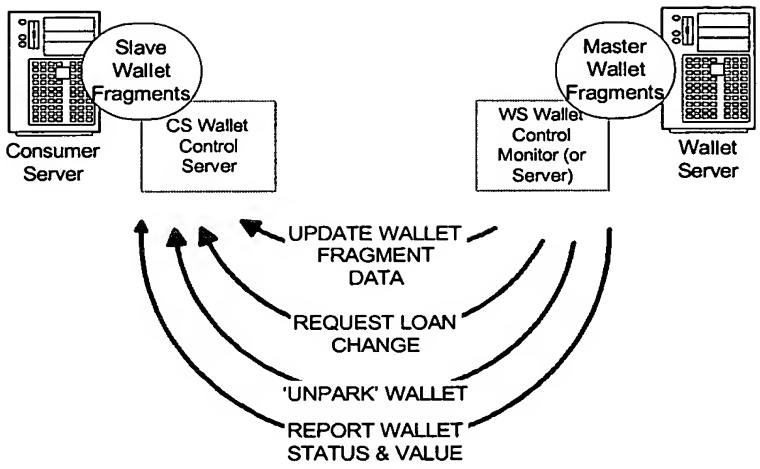

Figure 48B

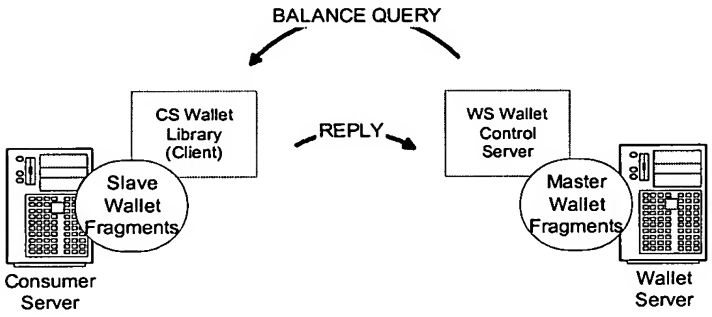

Figure 48C

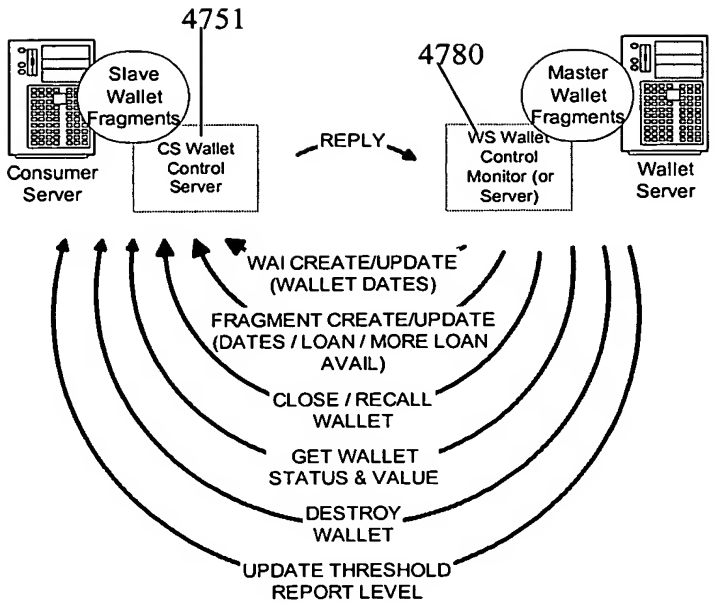
4751
4780
Slave
Wallet
Fragments
Master
Wallet
Fragments
REPLY
Consumer
Server
CS Wallet
Control
Server
WS Wallet
Control
Monitor (or
Server)
Wallet
Server
WAI CREATE/UPDATE
(WALLET DATES)
FRAGMENT CREATE/UPDATE
(DATES / LOAN / MORE LOAN
AVAIL)
CLOSE / RECALL
WALLET
GET WALLET
STATUS & VALUE
DESTROY
WALLET
UPDATE THRESHOLD
REPORT LEVEL

Figure 49

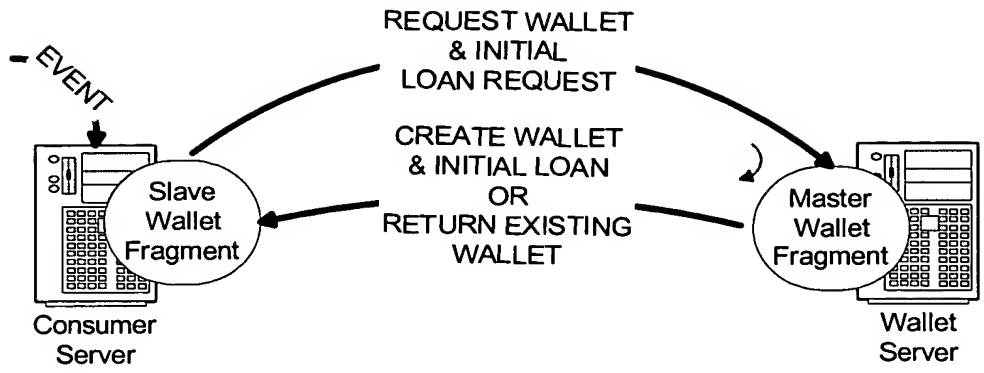

Figure 50A

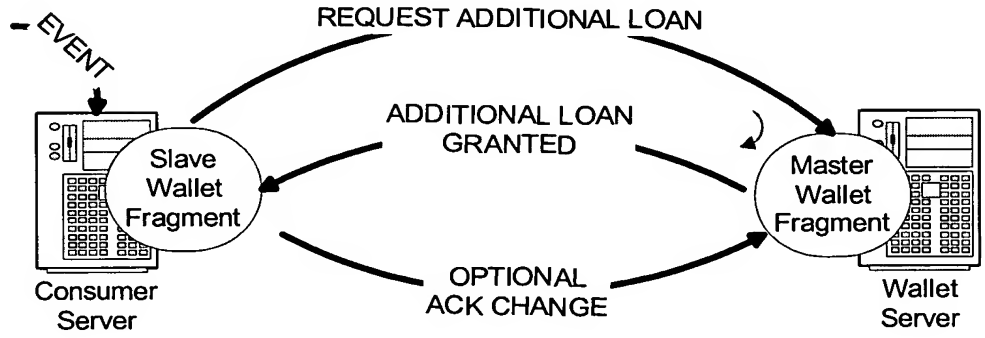

Figure 50B

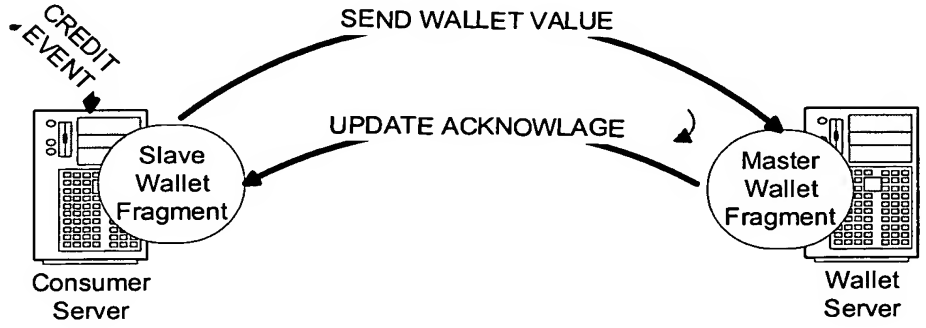

Figure 50C

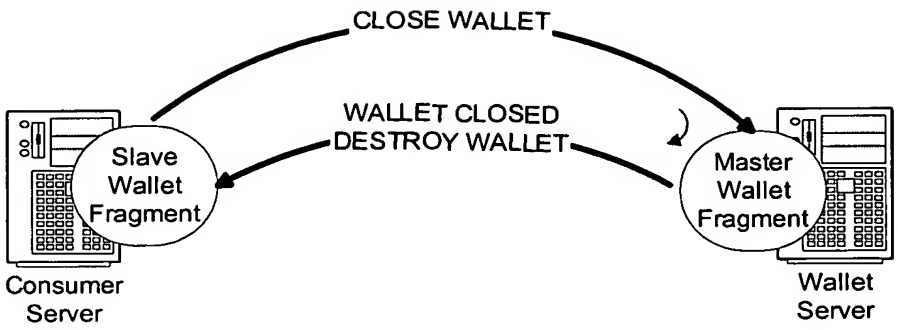

Figure 50D

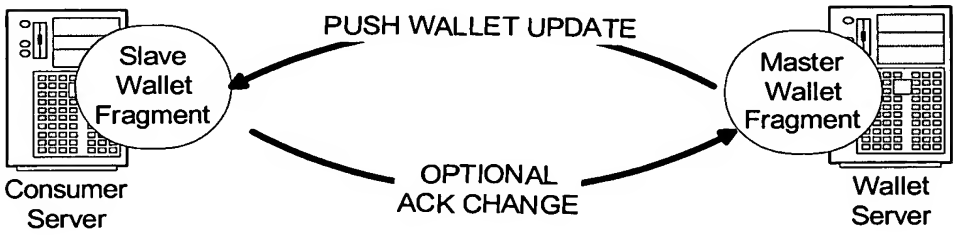

Figure 50E

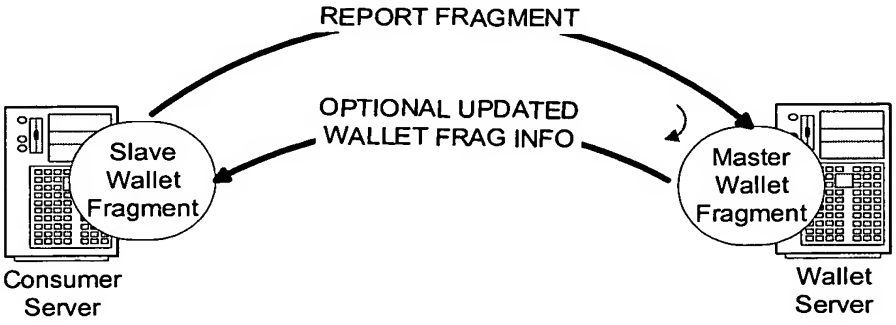

Figure 50F

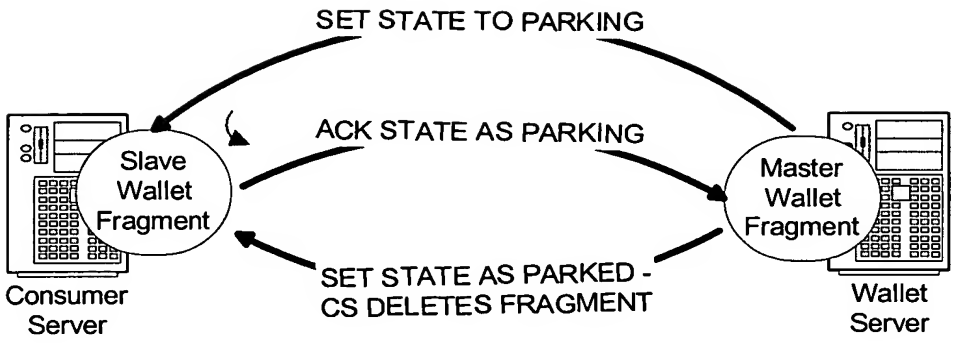

Figure 50G

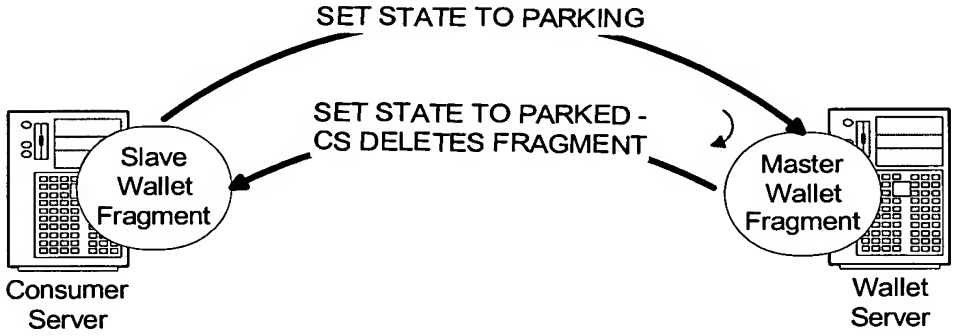

Figure 50H

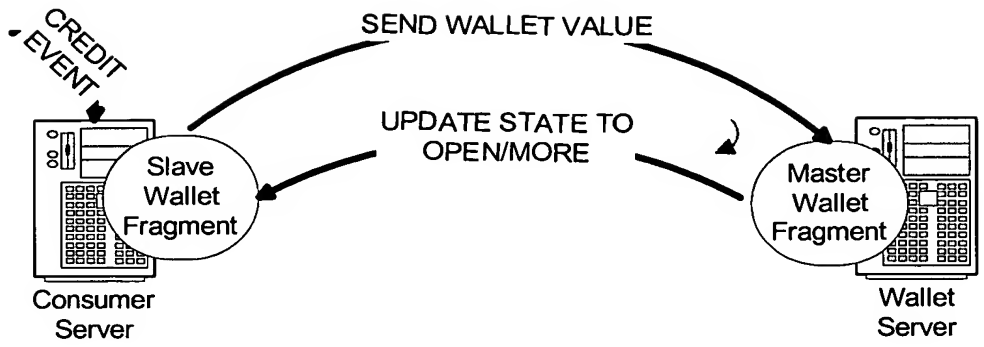

Figure 50I

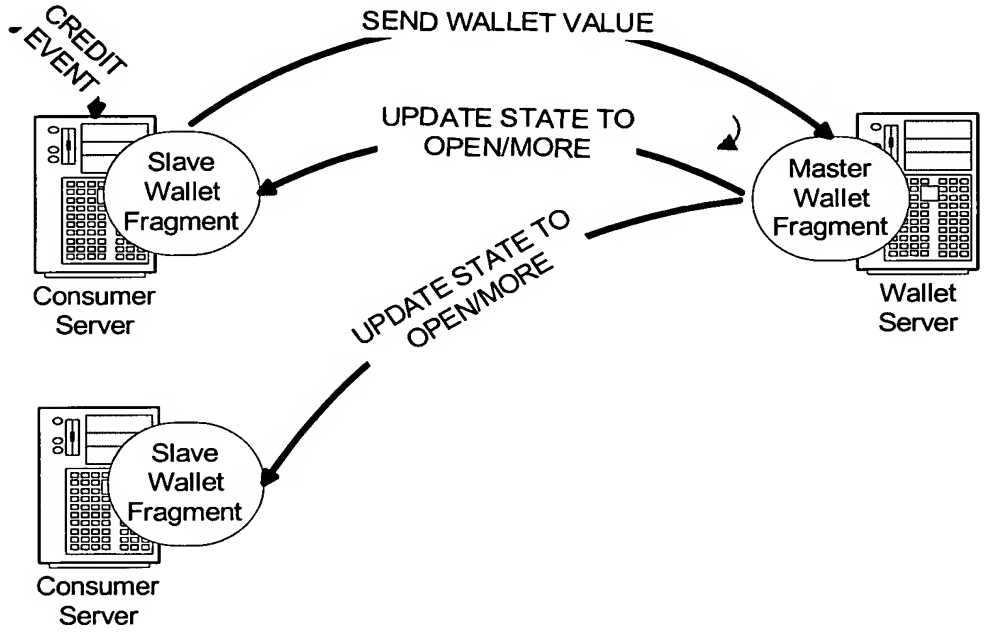

Figure 50J

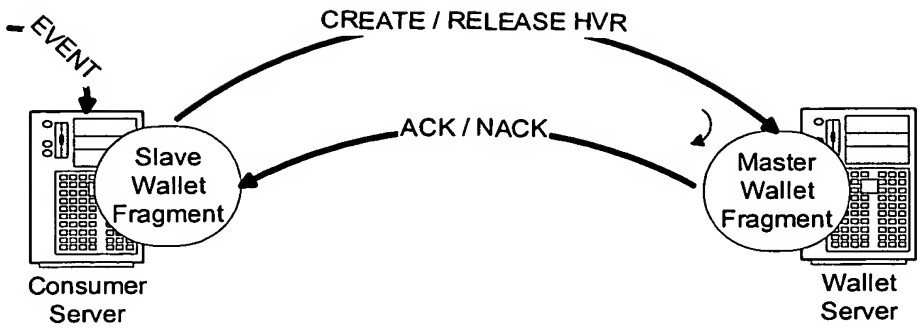

Figure 50K

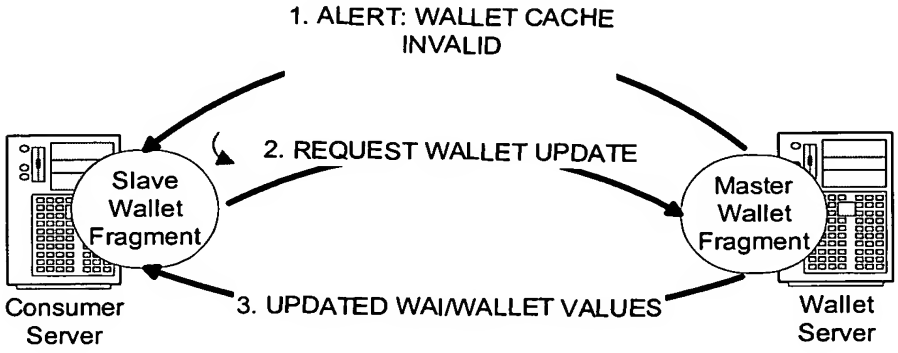

Figure 50L

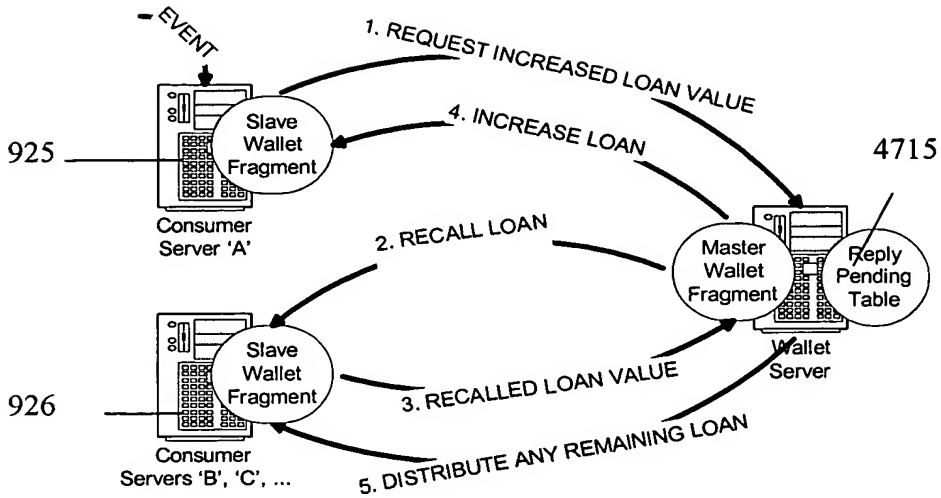
EVENT
1. REQUEST INCREASED LOAN VALUE
4. INCREASE LOAN
925
4715
Slave Wallet Fragment
Consumer Server 'A'
2. RECALL LOAN
Master Wallet Fragment
Reply Pending Table
Wallet Server
Slave Wallet Fragment
926
3. RECALLED LOAN VALUE
Consumer Servers 'B', 'C', ...
5. DISTRIBUTE ANY REMAINING LOAN

Figure 51

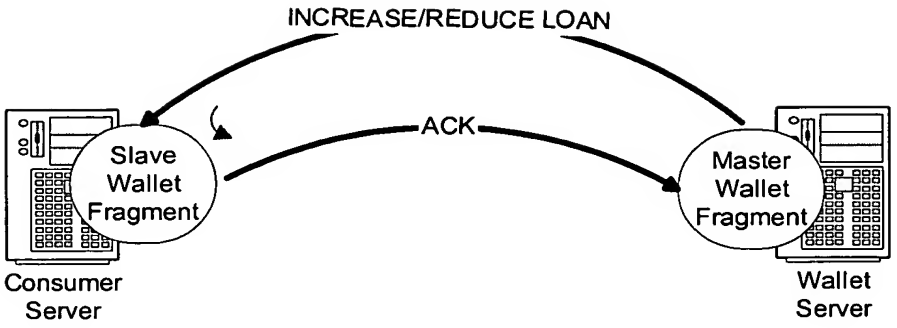

Figure 52

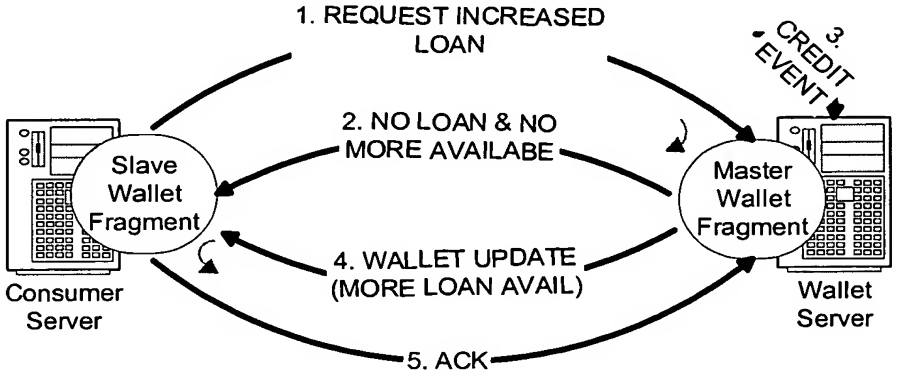

Figure 53

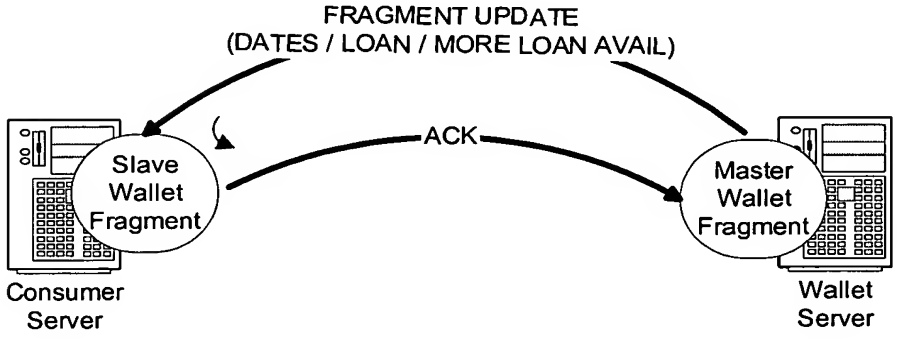

Figure 54

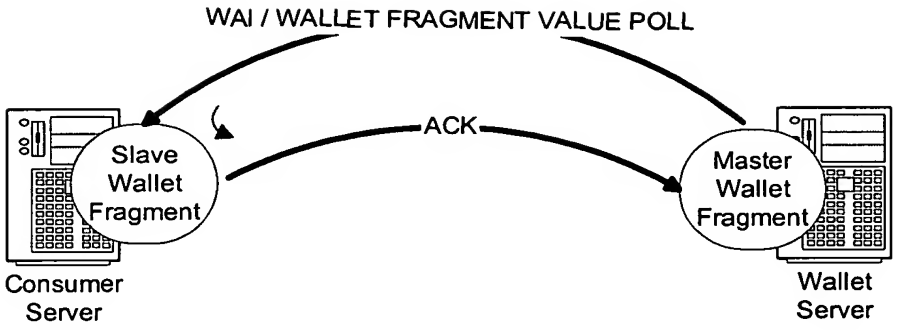

Figure 55

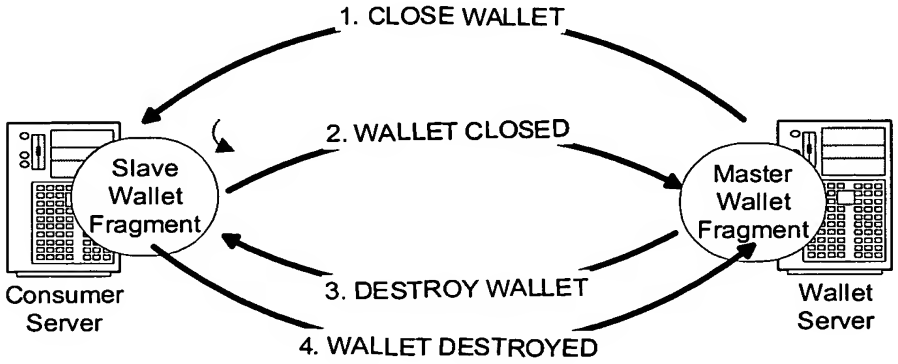

Figure 56

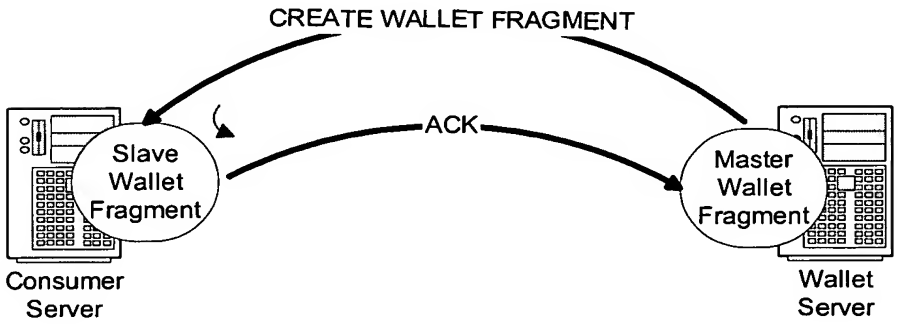

Figure 57

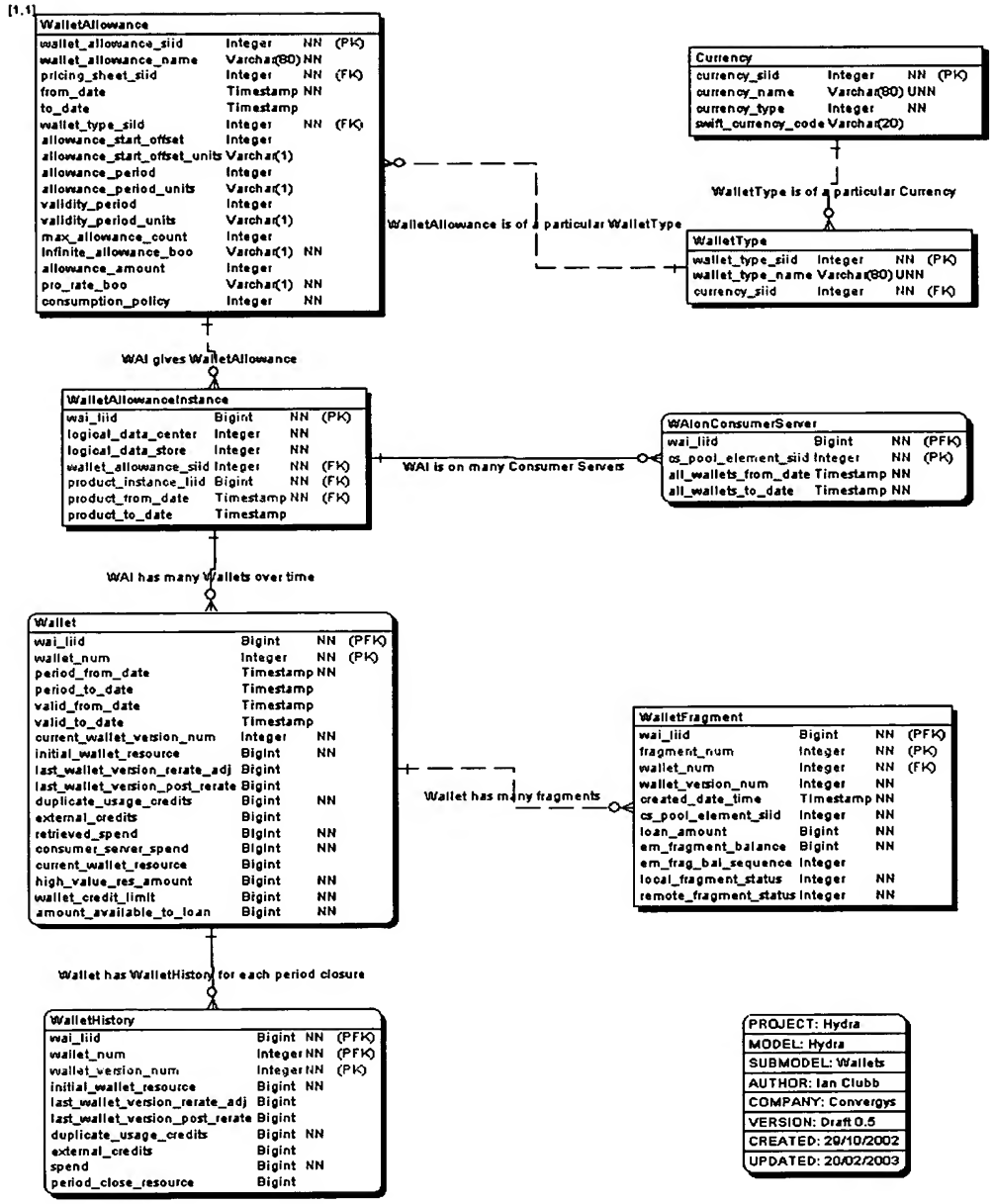
[1,1]
WalletAllowance
wallet_allowance_siid Integer NN (PK)
wallet_allowance_name Varchar(80) NN
pricing_sheet_siid Integer NN (FK)
from_date Timestamp NN
to_date Timestamp
wallet_type_siid Integer NN (FK)
allowance_start_offset Integer
allowance_start_offset_units Varchar(1)
allowance_period Integer
allowance_period_units Varchar(1)
validity_period Integer
validity_period_units Varchar(1)
max_allowance_count Integer
infinite_allowance_boo Varchar(1) NN
allowance_amount Integer
pro_rate_boo Varchar(1) NN
consumption_policy Integer NN
Currency
currency_siid Integer NN (PK)
currency_name Varchar(80) UNN
currency_type Integer NN
swift_currency_code Varchar(20)
WalletType is of a particular Currency
WalletAllowance is of a particular WalletType
WalletType
wallet_type_siid Integer NN (PK)
wallet_type_name Varchar(80) UNN
currency_siid Integer NN (FK)
WAI gives WalletAllowance
WalletAllowanceInstance
wai_liid Bigint NN (PK)
logical_data_center Integer NN
logical_data_store Integer NN
wallet_allowance_siid Integer NN (FK)
product_instance_liid Bigint NN (FK)
product_from_date Timestamp NN (FK)
product_to_date Timestamp
WAI is on many Consumer Servers
WAIonConsumerServer
wai_liid Bigint NN (PFK)
cs_pool_element_siid Integer NN (PK)
all_wallets_from_date Timestamp NN
all_wallets_to_date Timestamp NN
WAI has many Wallets over time
Wallet
wai_liid Bigint NN (PFK)
wallet_num Integer NN (PK)
period_from_date Timestamp NN
period_to_date Timestamp
valid_from_date Timestamp
valid_to_date Timestamp
current_wallet_version_num Integer NN
initial_wallet_resource Bigint NN
last_wallet_version_rerate_adj Bigint
last_wallet_version_post_rerate Bigint
duplicate_usage_credits Bigint NN
external_credits Bigint
retrieved_spend Bigint NN
consumer_server_spend Bigint NN
current_wallet_resource Bigint
high_value_res_amount Bigint NN
wallet_credit_limit Bigint NN
amount_available_to_loan Bigint NN
Wallet has many fragments
WalletFragment
wai_liid Bigint NN (PFK)
fragment_num Integer NN (PK)
wallet_num Integer NN (FK)
wallet_version_num Integer NN
created_date_time Timestamp NN
cs_pool_element_siid Integer NN
loan_amount Bigint NN
em_fragment_balance Bigint NN
em_frag_bal_sequence Integer
local_fragment_status Integer NN
remote_fragment_status Integer NN
Wallet has WalletHistory for each period closure
WalletHistory
wai_liid Bigint NN (PFK)
wallet_num Integer NN (PFK)
wallet_version_num Integer NN (PK)
initial_wallet_resource Bigint NN
last_wallet_version_rerate_adj Bigint
last_wallet_version_post_rerate Bigint
duplicate_usage_credits Bigint NN
external_credits Bigint
spend Bigint NN
period_close_resource Bigint
PROJECT: Hydra
MODEL: Hydra
SUBMODEL: Wallets
AUTHOR: Ian Clubb
COMPANY: Convergys
VERSION: Draft 0.5
CREATED: 20/10/2002
UPDATED: 20/02/2003

Figure 58

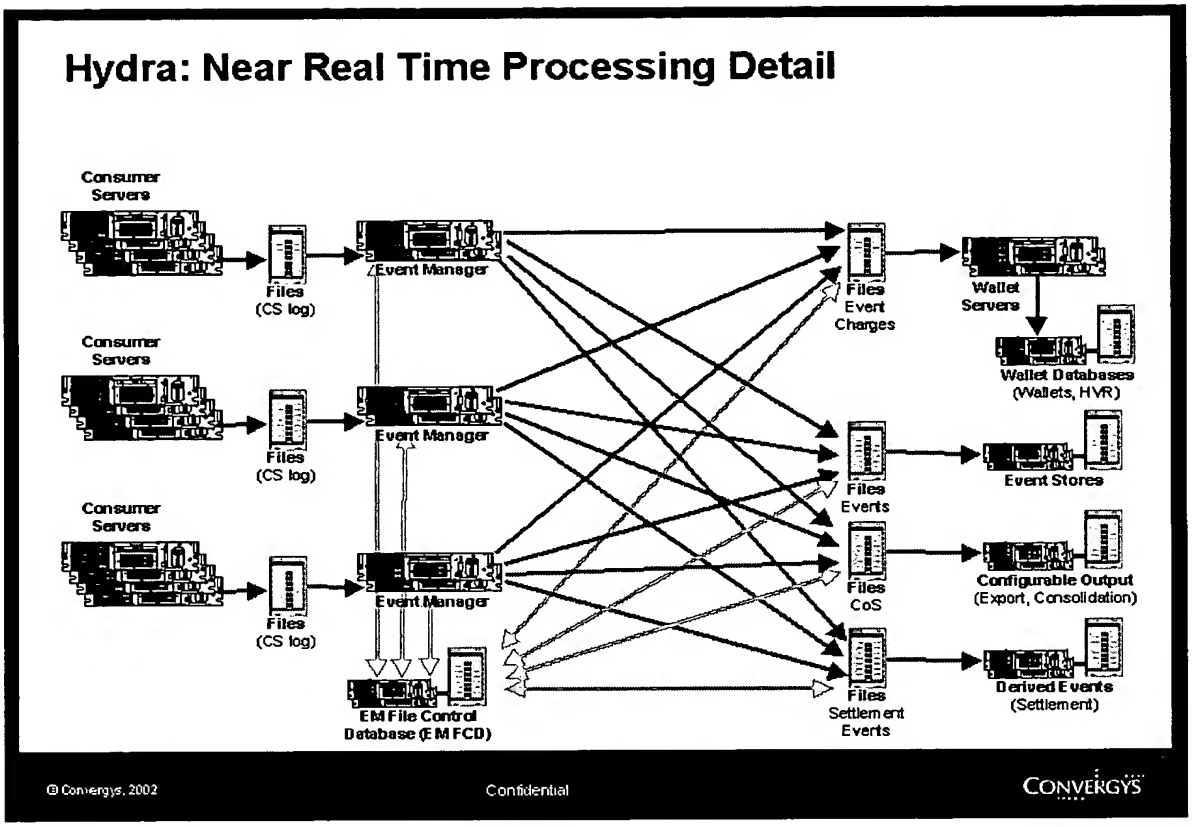
Hydra: Near Real Time Processing Detail
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EM FCD)
Files Event Charges
Files Everts
Files CoS
Files Settlement Everts
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
© Convergys, 2002
Confidential
CONVERGYS

Figure 59

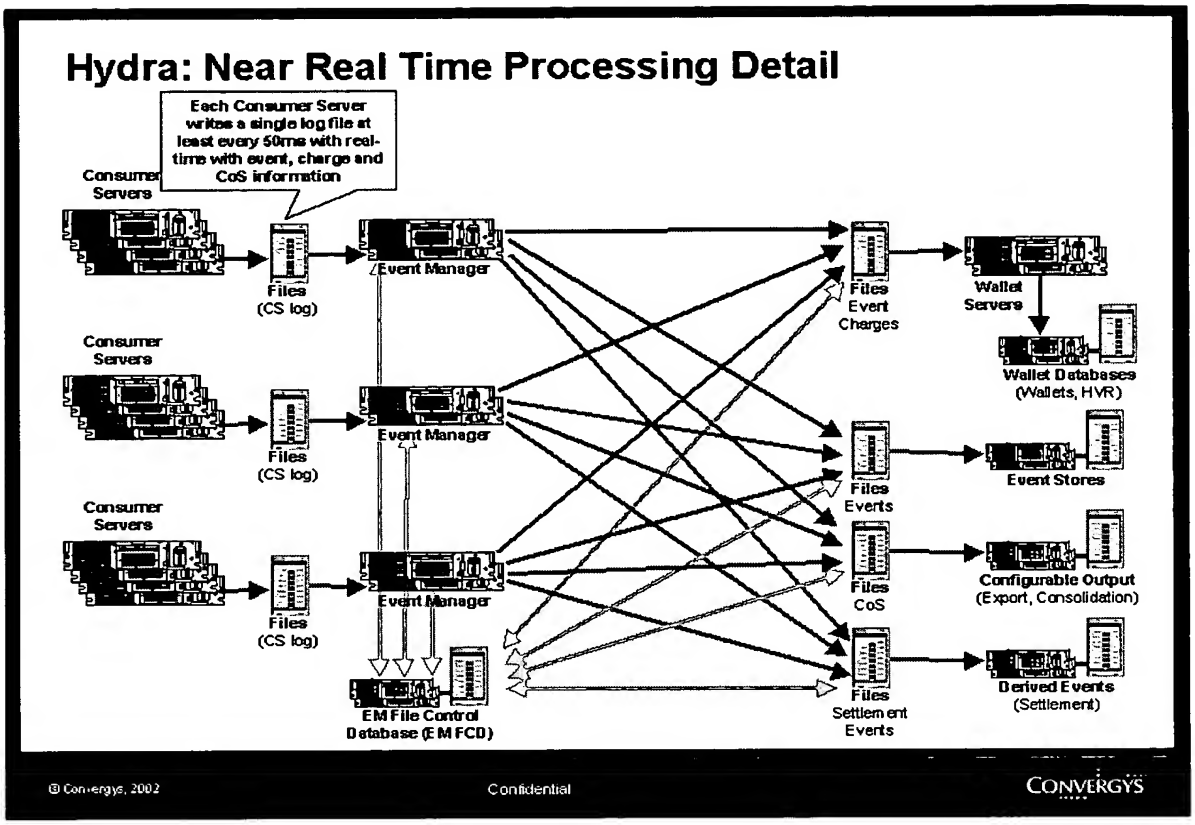
Hydra: Near Real Time Processing Detail
Each Consumer Server writes a single log file at least every 50ms with real-time with event, charge and CoS information
Consumer Servers
Files (CS log)
Event Manager
Files Event Charges
Wallet Servers
Wallet Databases (Wallets, HVR)
Files Events
Event Stores
Files CoS
Configurable Output (Export, Consolidation)
Files Settlement Events
Derived Events (Settlement)
EM File Control Database (EMFCD)
© Convergys, 2002
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Figure 60

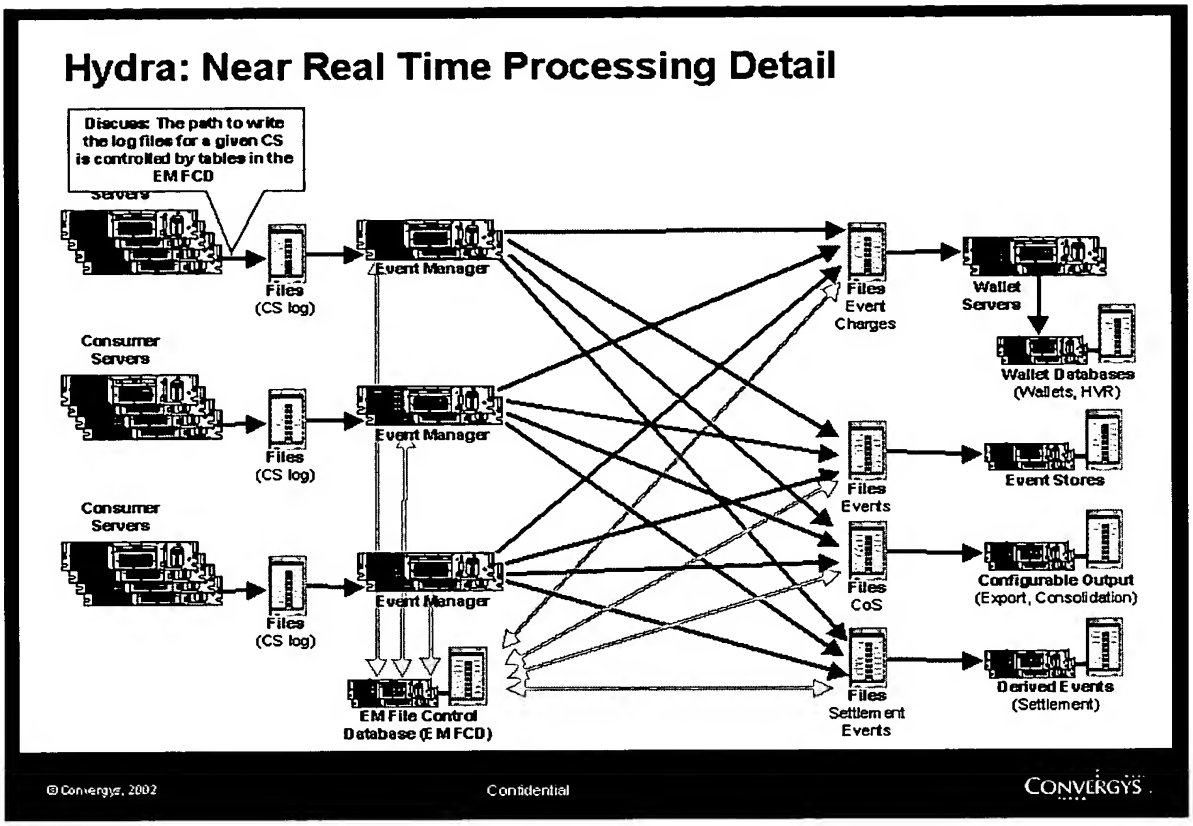
Hydra: Near Real Time Processing Detail
Discuss: The path to write the log files for a given CS is controlled by tables in the EMFCD
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EMFCD)
Files Event Charges
Files Events
Files CoS
Files Settlement Events
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
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Figure 61

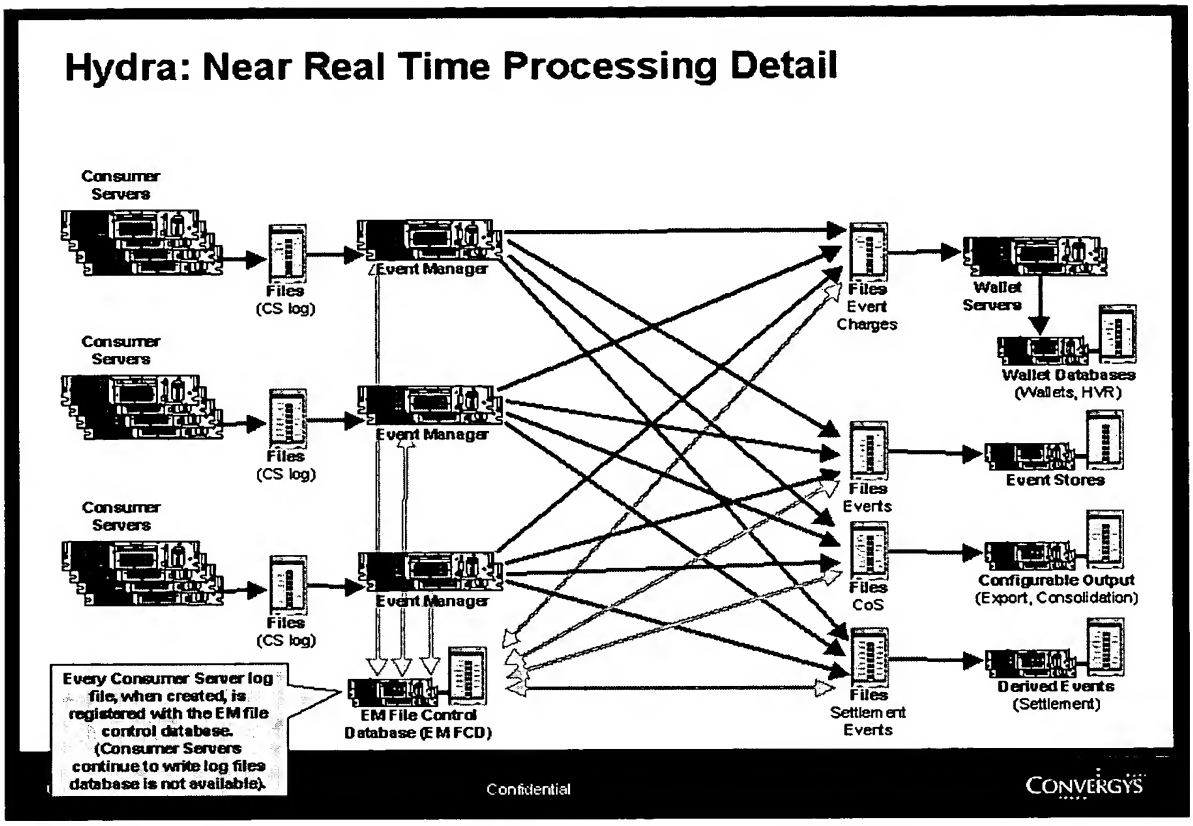
Hydra: Near Real Time Processing Detail
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Every Consumer Server log file, when created, is registered with the EM file control database. (Consumer Servers continue to write log files database is not available).
EM File Control Database (EMFCD)
Files Event Charges
Files Everts
Files CoS
Files Settlement Events
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
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Figure 62

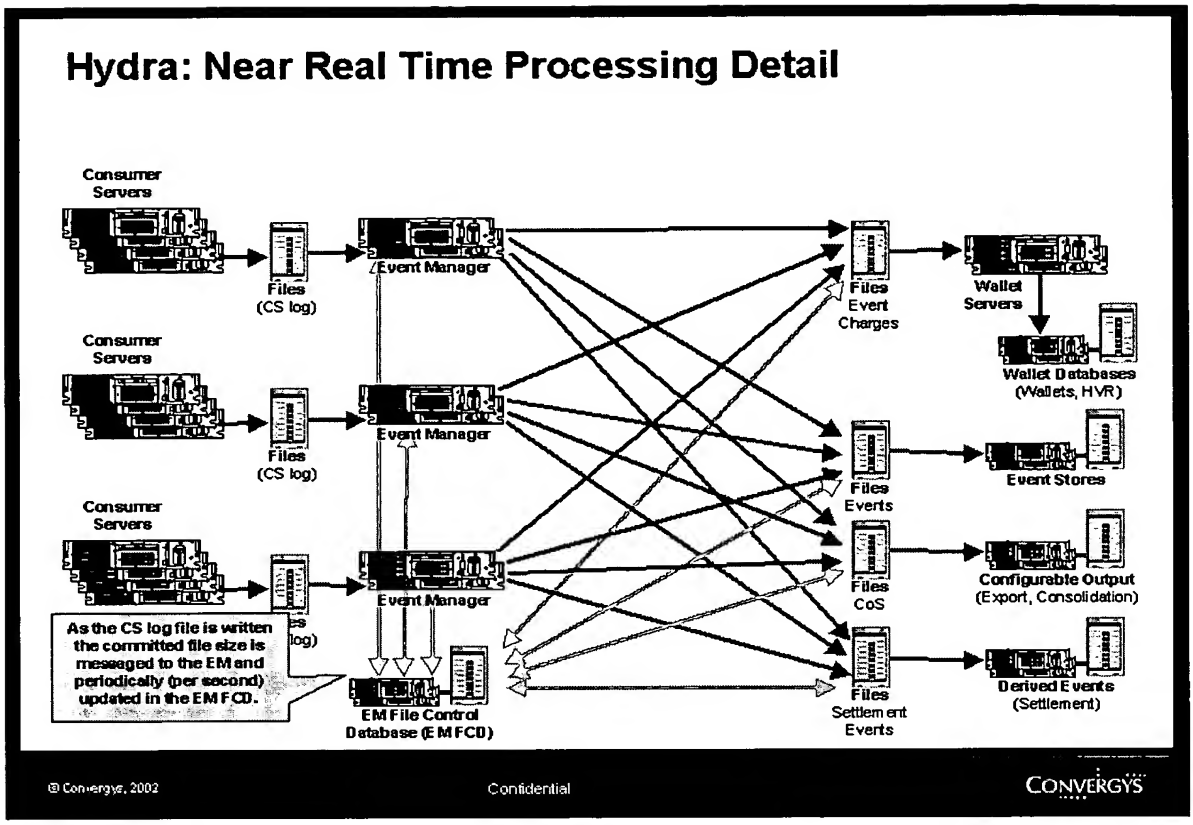
Hydra: Near Real Time Processing Detail
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Event Manager
As the CS log file is written the committed file size is messaged to the EM and periodically (per second) updated in the EMFCD.
EM File Control Database (EMFCD)
Files Event Charges
Files Events
Files CoS
Files Settlement Events
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
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Figure 63

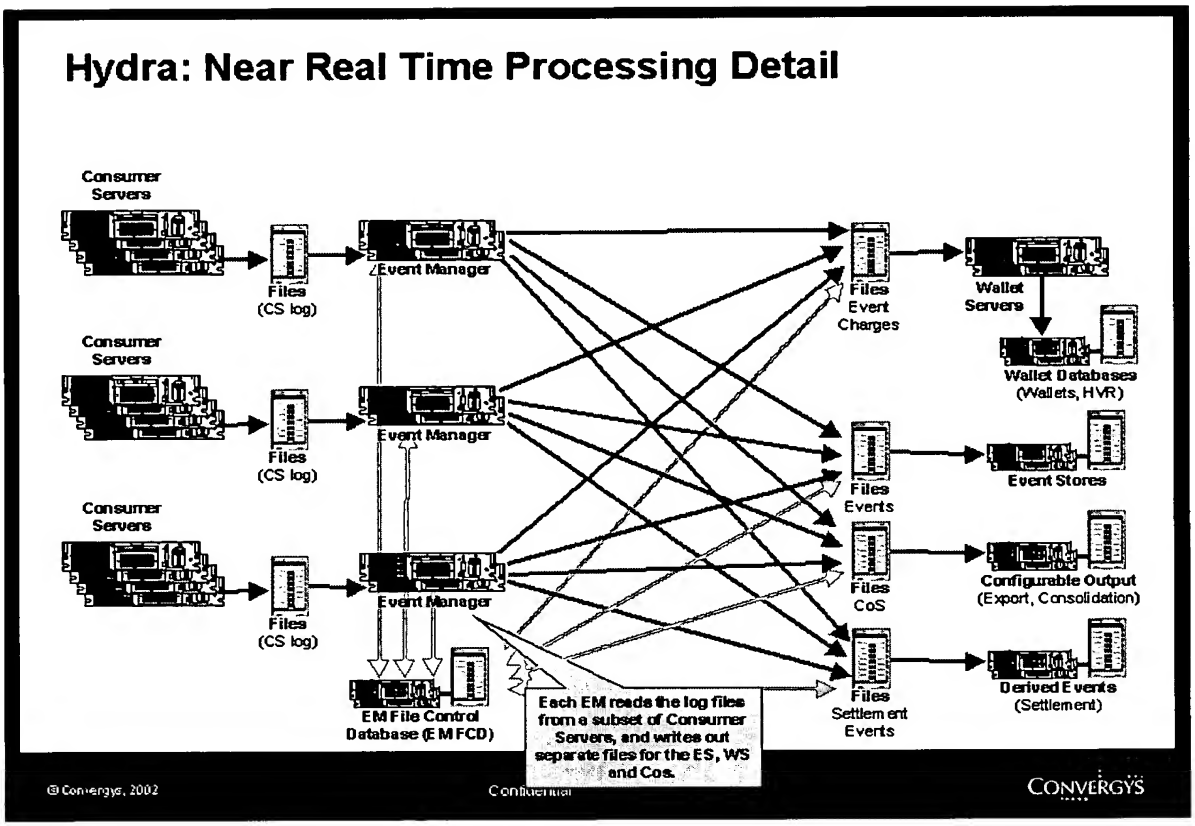
Hydra: Near Real Time Processing Detail
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EMFCD)
Each EM reads the log files from a subset of Consumer Servers, and writes out separate files for the ES, WS and CoS.
Files Evert Charges
Files Everts
Files CoS
Files Settlement Everts
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
© Convergys, 2002
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Figure 64

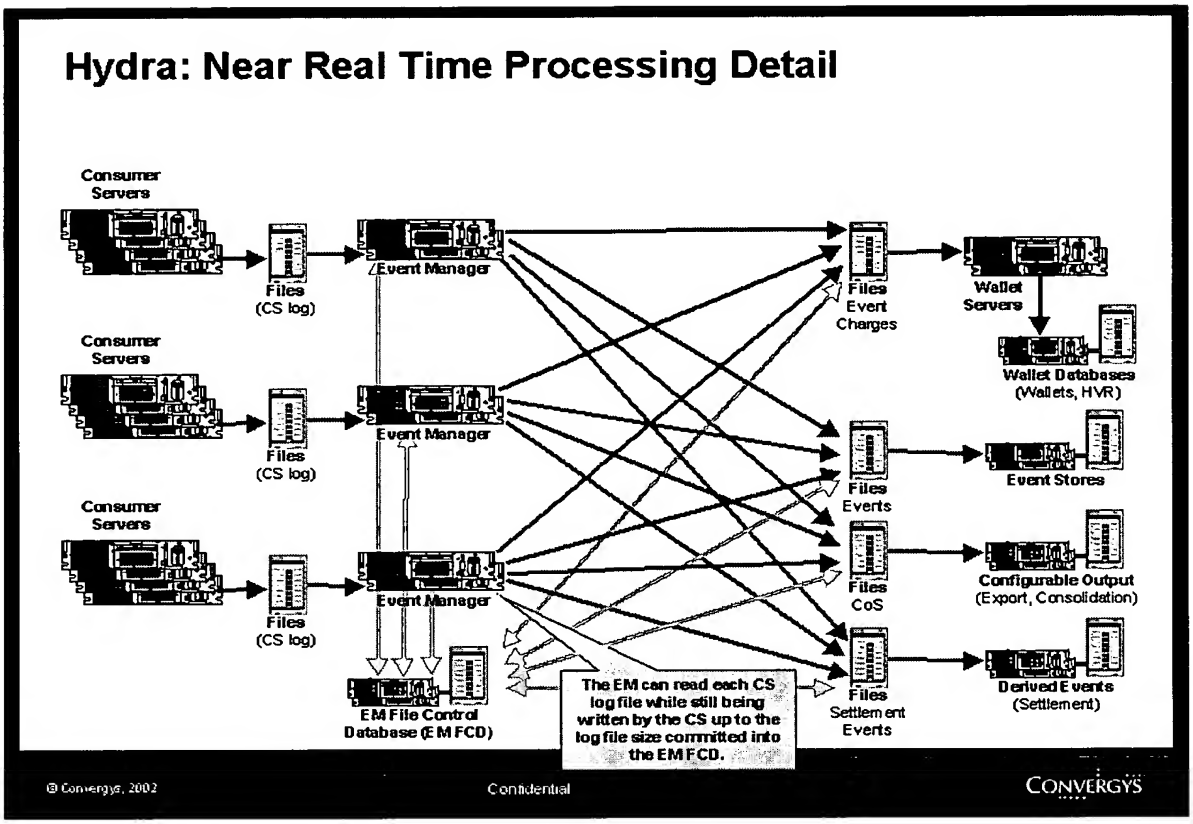
Hydra: Near Real Time Processing Detail
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EMFCD)
The EM can read each CS log file while still being written by the CS up to the log file size committed into the EMFCD.
Files Event Charges
Files Events
Files CoS
Files Settlement Events
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
© Convergys, 2002
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Figure 65

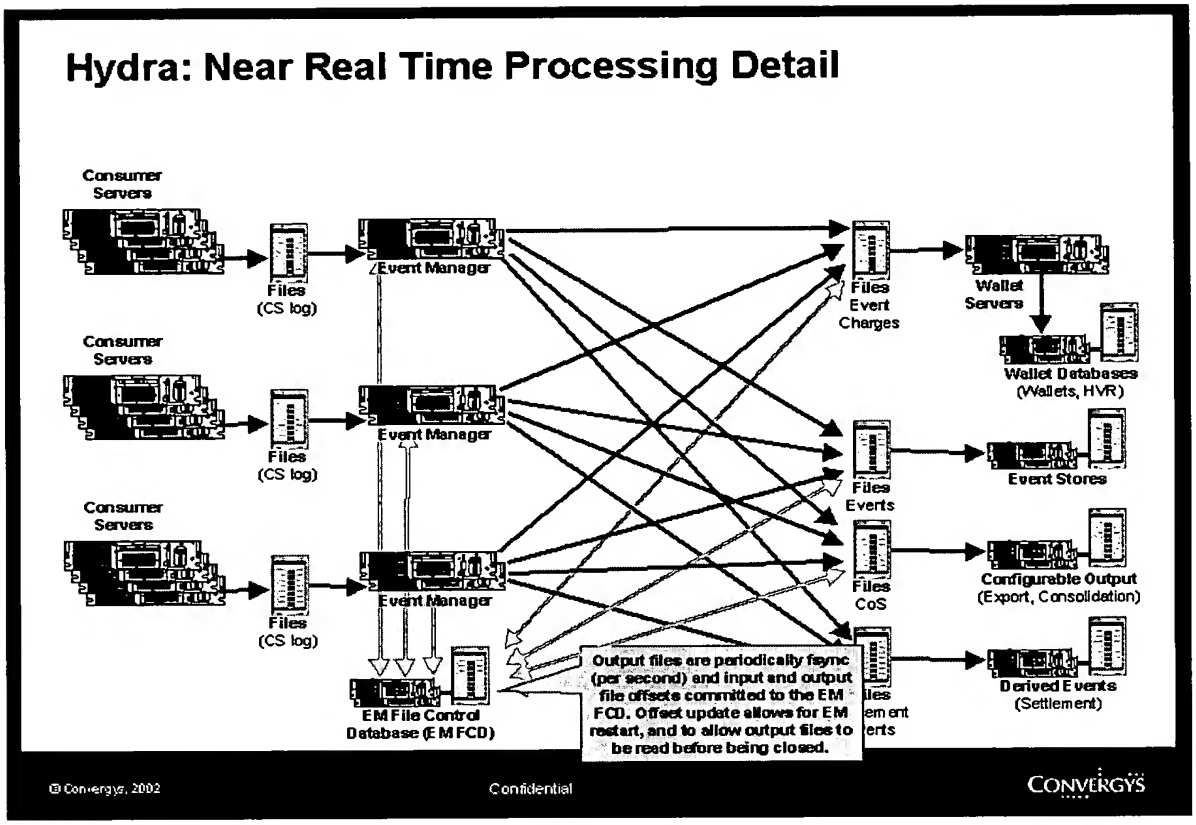
Hydra: Near Real Time Processing Detail
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EM FCD)
Output files are periodically fsync (per second) and input and output file offsets committed to the EM FCD. Offset update allows for EM restart, and to allow output files to be read before being closed.
Files Event Charges
Files Events
Files CoS
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
© Convergys, 2002
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Figure 66

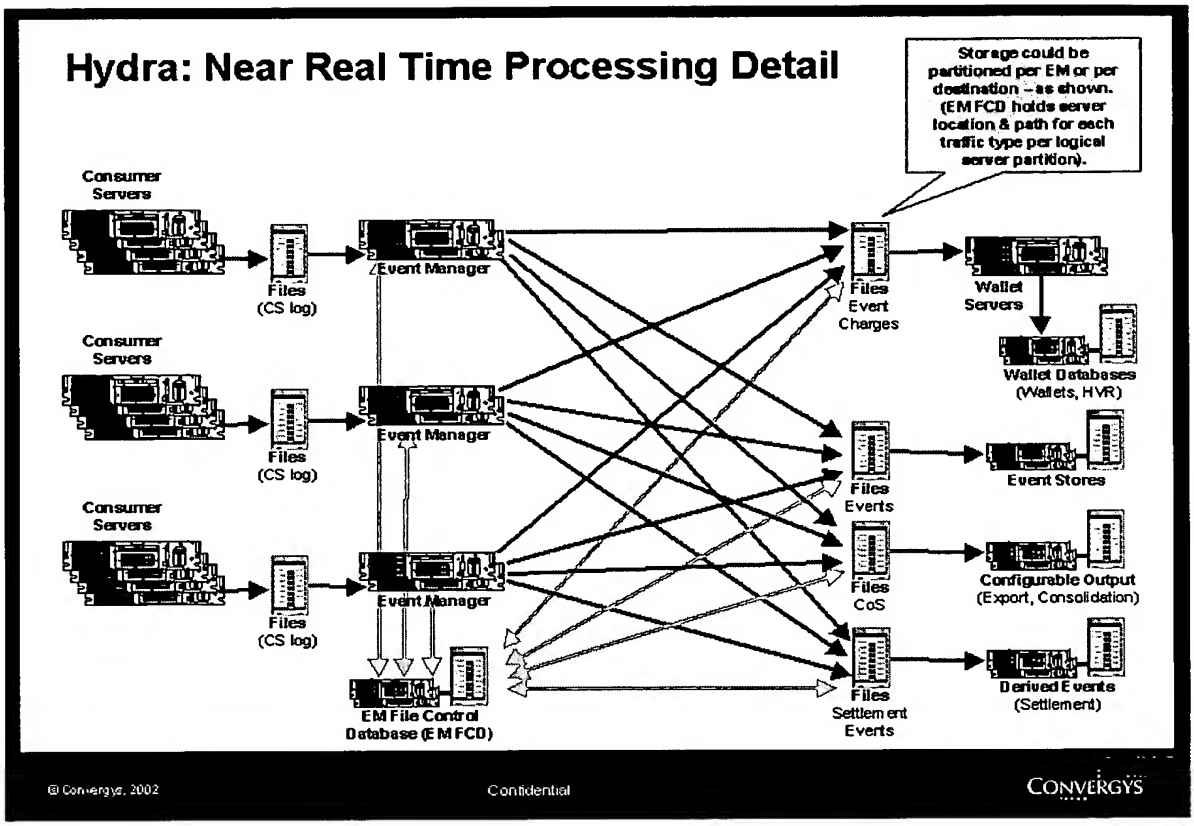
Hydra: Near Real Time Processing Detail
Storage could be partitioned per EM or per destination – as shown. (EMFCD holds server location & path for each traffic type per logical server partition).
Consumer Servers
Files (CS log)
Event Manager
Files Evert Charges
Wallet Servers
Wallet Databases (Wallets, HVR)
Consumer Servers
Files (CS log)
Event Manager
Files Events
Event Stores
Consumer Servers
Files (CS log)
Event Manager
Files CoS
Configurable Output (Export, Consolidation)
EM File Control Database (EMFCD)
Files Settlement Events
Derived Events (Settlement)
© Convergys, 2002
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Figure 67

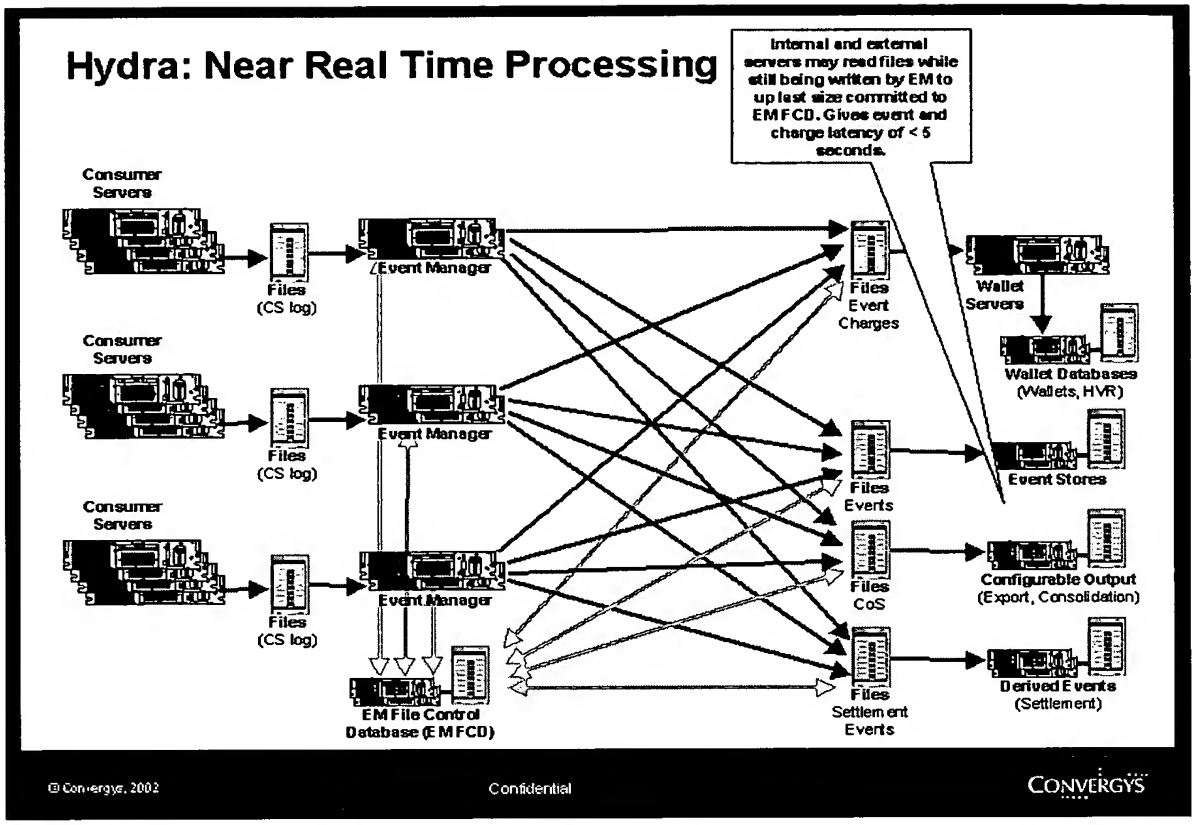
Hydra: Near Real Time Processing
Internal and external servers may read files while still being written by EM to up last size committed to EMFCD. Gives event and charge latency of < 5 seconds.
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EMFCD)
Files Evert Charges
Files Events
Files CoS
Files Settlement Events
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
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Figure 68

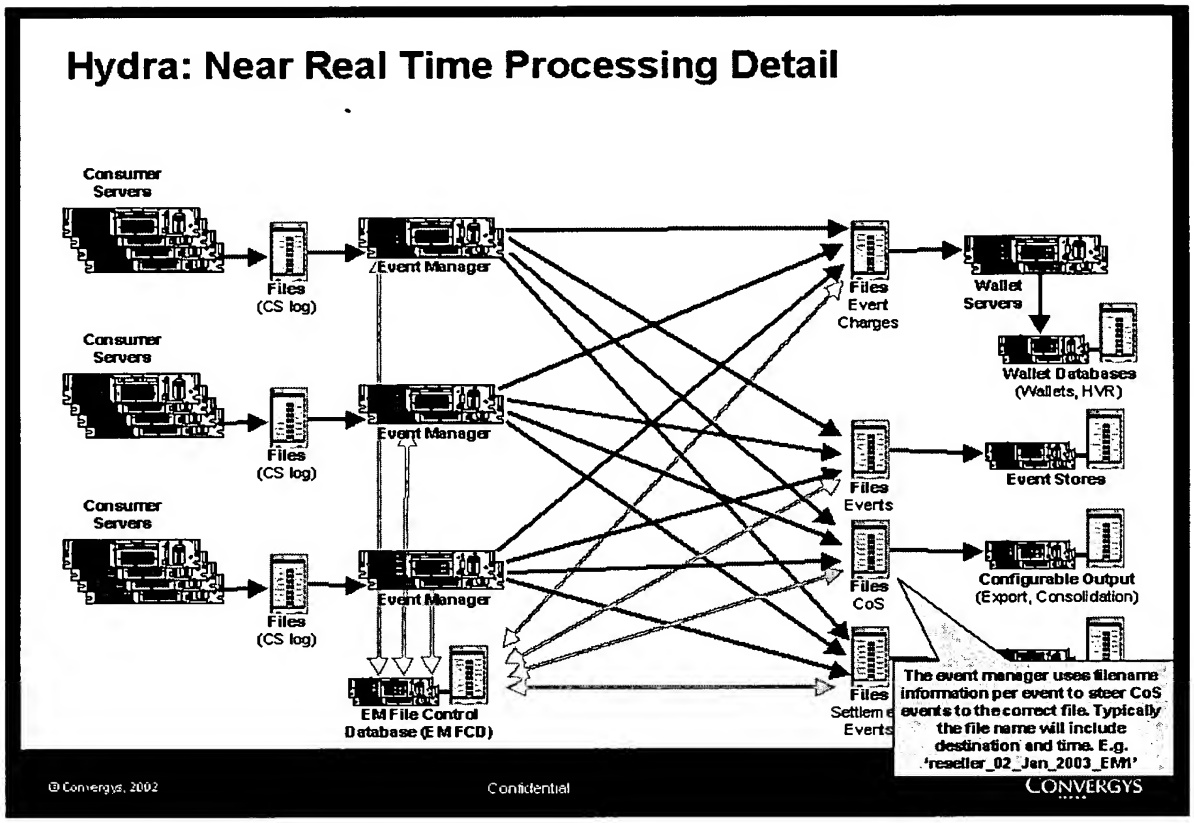
Hydra: Near Real Time Processing Detail
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EMFCD)
Files Evert Charges
Files Everts
Files CoS
Files Settlem e Everts
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
The event manager uses filename information per event to steer CoS events to the correct file. Typically the file name will include destination and time. E.g. 'reseller_02_Jan_2003_EM1'
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Figure 69

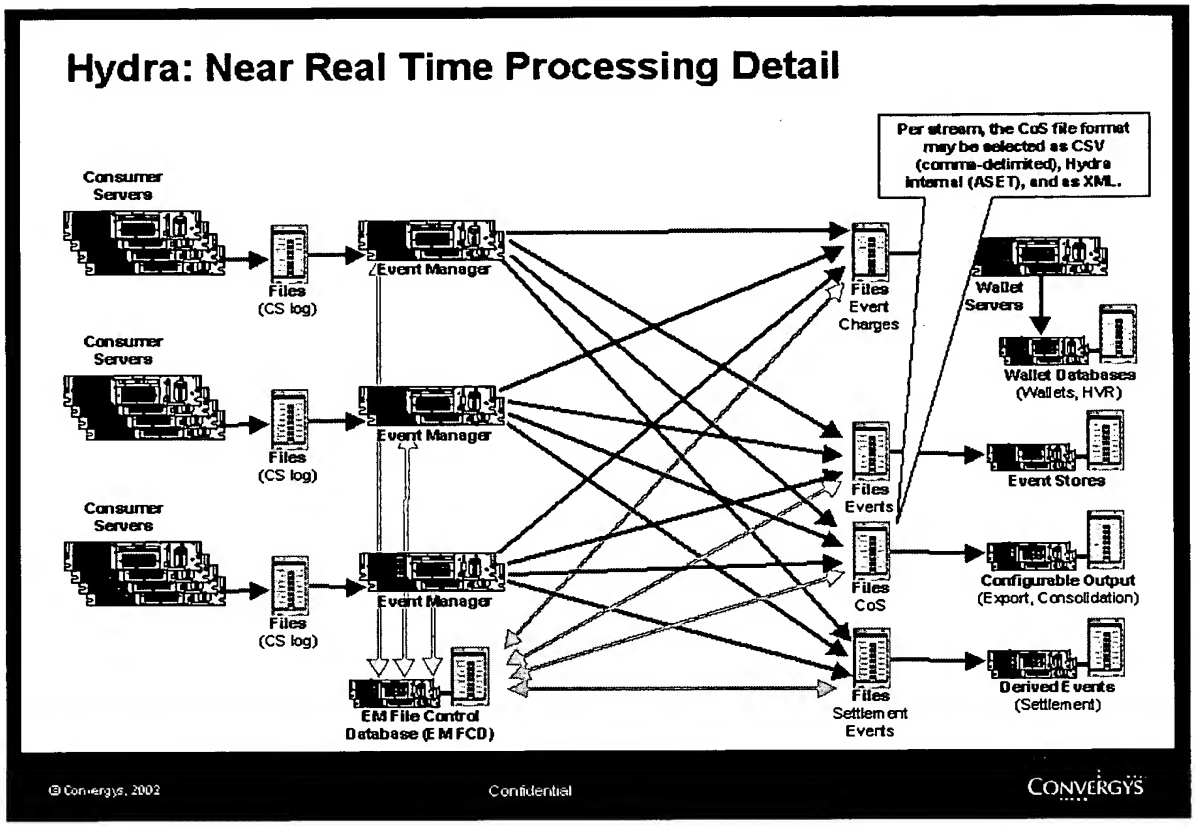
Hydra: Near Real Time Processing Detail
Per stream, the CoS file format may be selected as CSV (comma-delimited), Hydra internal (ASET), and as XML.
Consumer Servers
Files (CS log)
Event Manager
Files Event Charges
Wallet Servers
Wallet Databases (Wallets, HVR)
Consumer Servers
Files (CS log)
Event Manager
Files Events
Event Stores
Consumer Servers
Files (CS log)
Event Manager
Files CoS
Configurable Output (Export, Consolidation)
EM File Control Database (EMFCD)
Files Settlement Events
Derived Events (Settlement)
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Figure 70

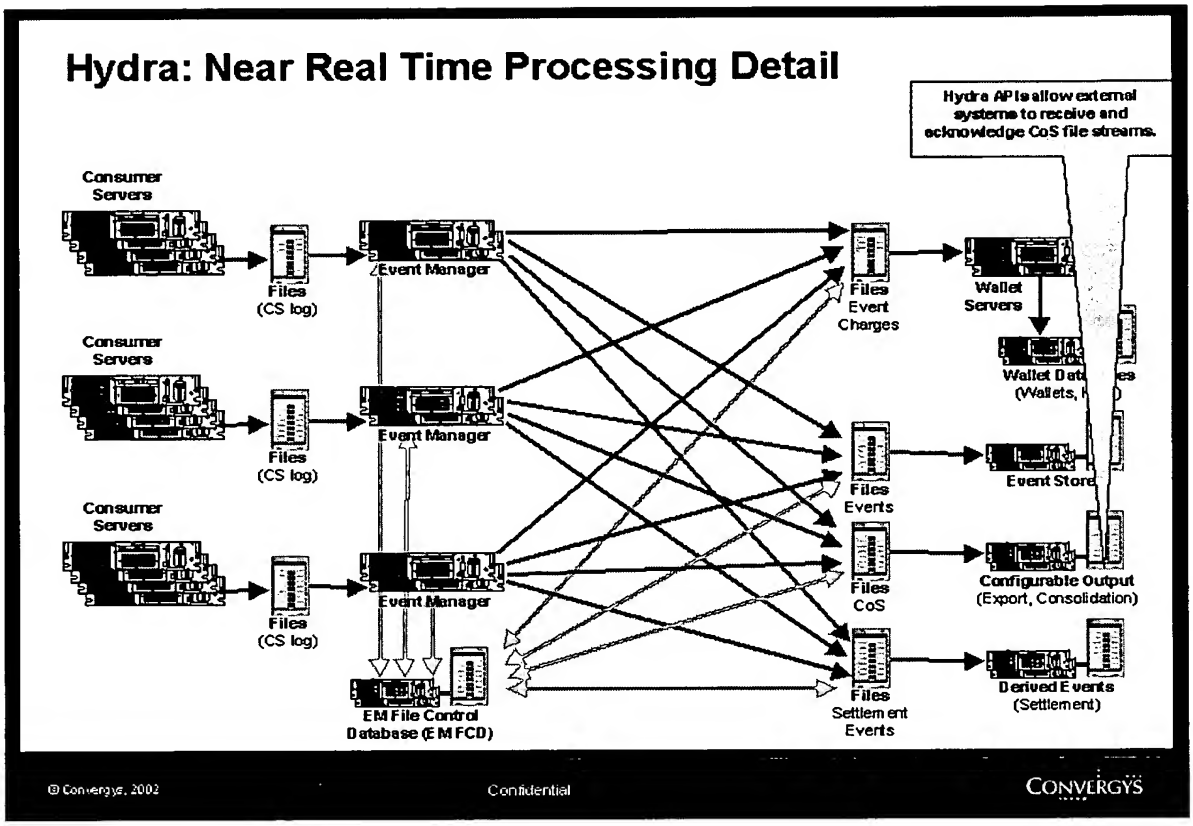
Hydra: Near Real Time Processing Detail
Hydra APIs allow external systems to receive and acknowledge CoS file streams.
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EMFCD)
Files Event Charges
Files Events
Files CoS
Files Settlement Events
Wallet Servers
Wallet Dat
(Wallets,
Event Store
Configurable Output
(Export, Consolidation)
Derived Events
(Settlement)
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Figure 71

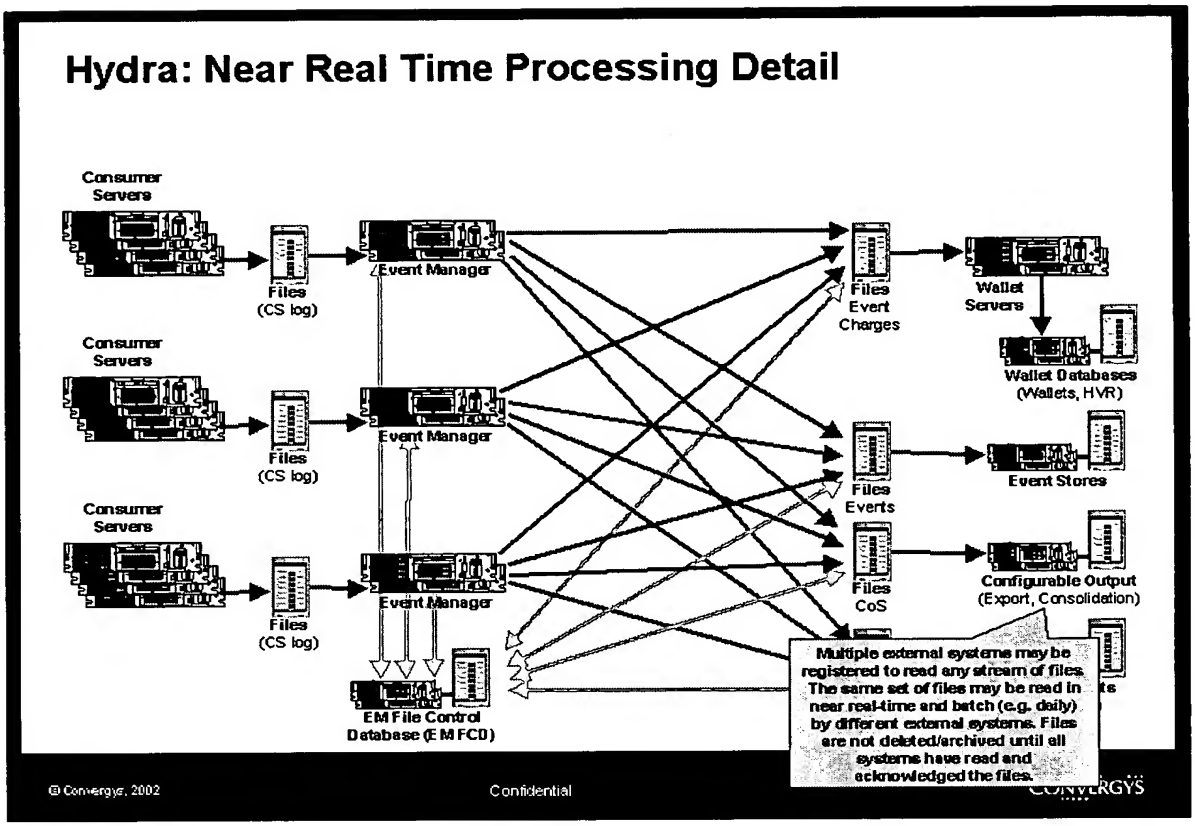
Hydra: Near Real Time Processing Detail
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EMFCD)
Files Event Charges
Files Everts
Files CoS
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Multiple external systems may be registered to read any stream of files. The same set of files may be read in near real-time and batch (e.g. daily) by different external systems. Files are not deleted/archived until all systems have read and acknowledged the files.
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Figure 72

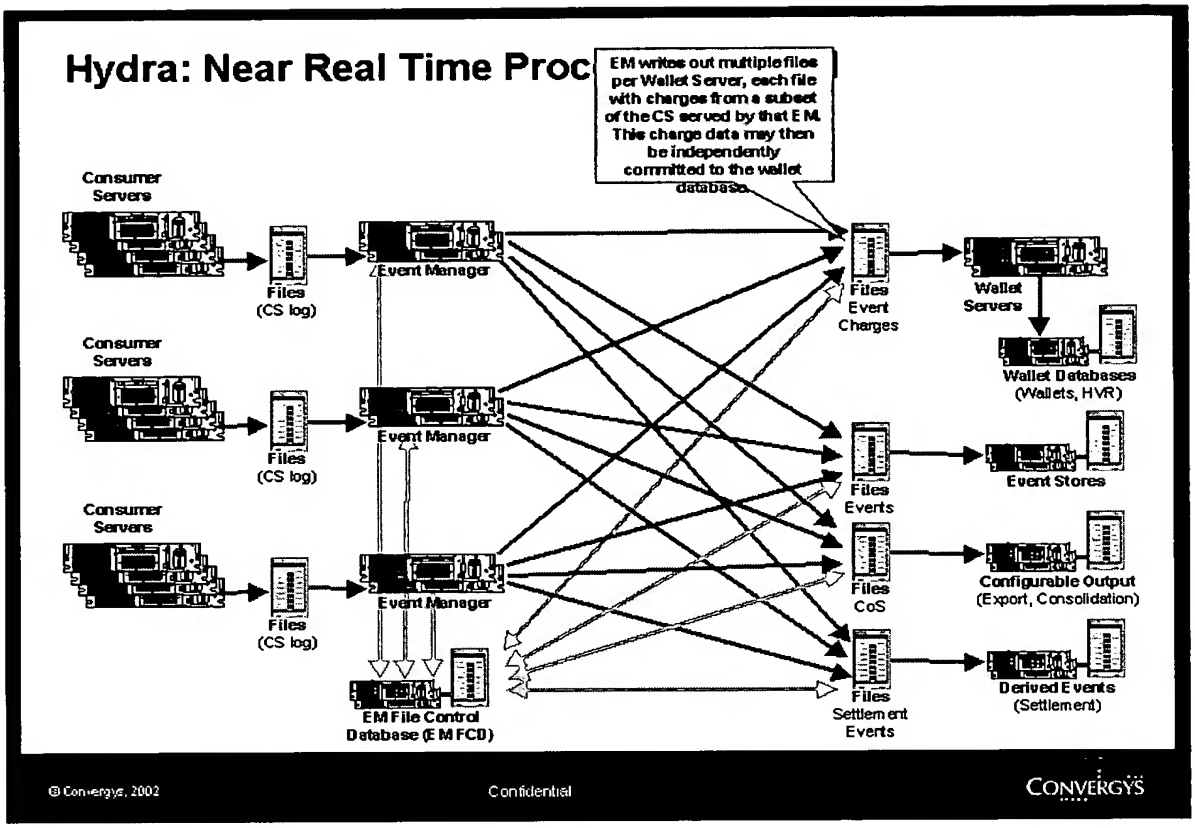
Hydra: Near Real Time Proc
EM writes out multiple files per Wallet Server, each file with charges from a subset of the CS served by that EM. This charge data may then be independently committed to the wallet database.
Consumer Servers
Consumer Servers
Consumer Servers
Files (CS log)
Files (CS log)
Files (CS log)
Event Manager
Event Manager
Event Manager
EM File Control Database (EMFCD)
Files Event Charges
Files Events
Files CoS
Files Settlement Events
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
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Figure 73

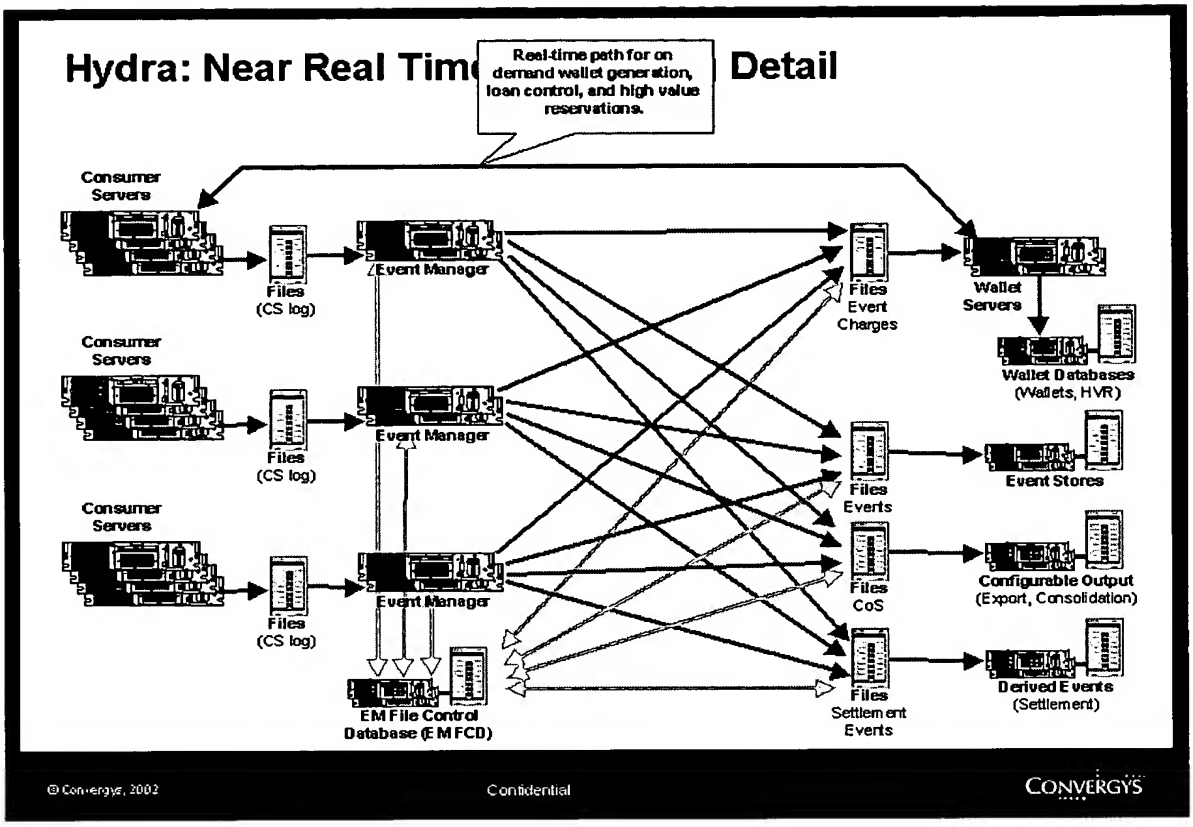
Hydra: Near Real Time Detail
Real-time path for on demand wallet generation, loan control, and high value reservations.
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
Consumer Servers
Files (CS log)
Event Manager
EM File Control Database (EMFCD)
Files Event Charges
Files Events
Files CoS
Files Settlement Events
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Configurable Output (Export, Consolidation)
Derived Events (Settlement)
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Figure 74

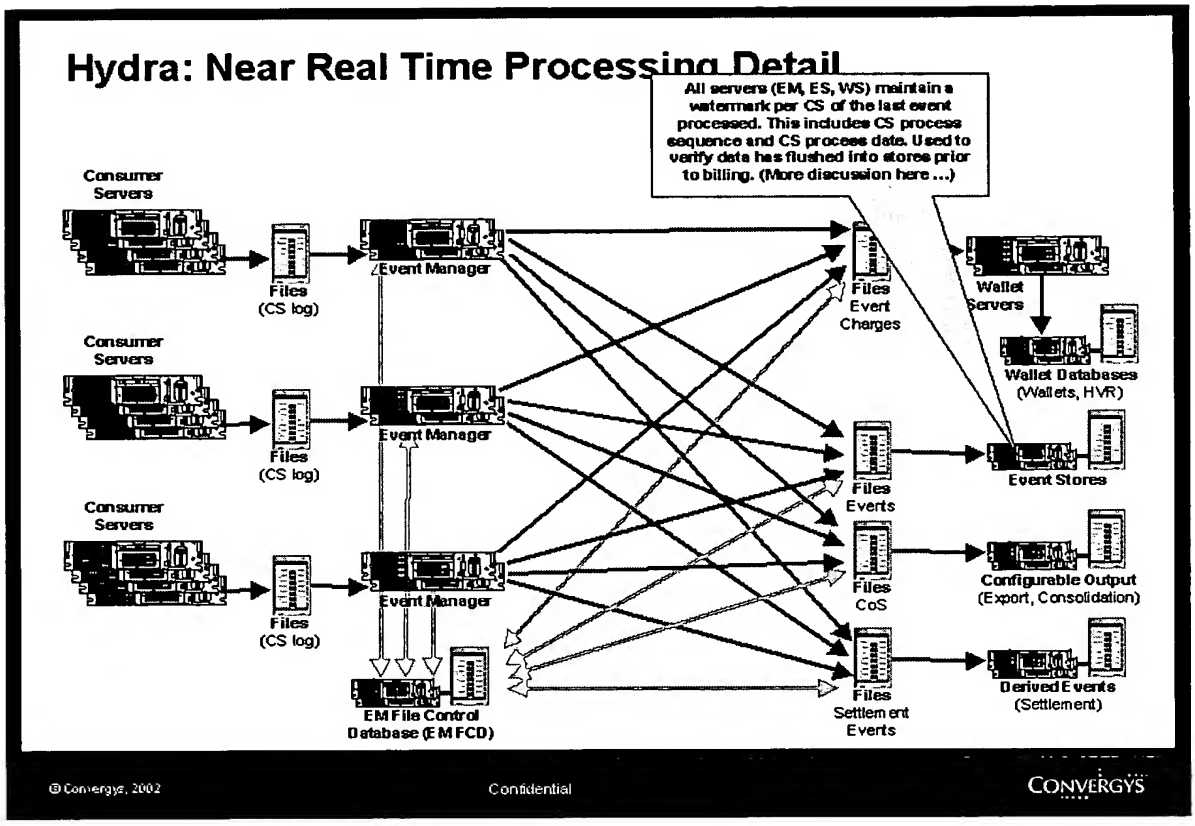
Hydra: Near Real Time Processing Detail
All servers (EM, ES, WS) maintain a watermark per CS of the last event processed. This includes CS process sequence and CS process date. Used to verify data has flushed into stores prior to billing. (More discussion here ...)
Consumer Servers
Files (CS log)
Event Manager
Files Event Charges
Wallet Servers
Wallet Databases (Wallets, HVR)
Event Stores
Files Events
Configurable Output (Export, Consolidation)
Files CoS
Derived Events (Settlement)
Files Settlement Events
EM File Control Database (EMFCD)
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Figure 75